UNITED STATES DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, Secretary
BUREAU OF MINES
JOHN W. FINCH, Director

MINERALS YEARBOOK

1939

Compiled under the supervision of
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Economics and Statistics Branch

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FOREWORD

In Minerals Yearbook, 1939, the Bureau of Mines presents an economic review and statistical summary of the mineral industry of the United States in 1938. This annual service was inaugurated in 1866 and since 1925 has been the principal function of the Economics and Statistics Branch of the Bureau of Mines. In the performance of its duty this branch of the Bureau endeavors to supply producers and consumers of mineral products, as well as the general public, with as much factual data as is possible with the limited funds appropriated for this purpose. Every effort is made to maintain the high standard of accuracy that has prevailed in the past, and at the same time to publish the finished volume at the earliest possible date. In view of the tremendous importance of mining to the industrial life of the United States, the constantly increasing difficulty of finding new deposits and maintaining production from old ones, and the growing realization of the significance of minerals in international affairs, the necessity for official fact-finding of the type presented in this series of publications cannot be overemphasized.

Unfortunately, the year 1938 was a poor one for the mineral industry. The industrial recession that began the latter part of 1937 continued at an accelerated rate in the first half of 1938. With production schedules geared to 1937 requirements, stocks mounted rapidly as sales fell abruptly; prices declined accordingly. In some commodities midyear inventories exceeded or approached the depression highs established in 1932 and 1933. Prices, however, did not reach the distress levels of 1932. During the last half of 1938 there was substantial improvement. Sales increased appreciably, and curtailment programs begun earlier in the year were effective in cutting down production. Stocks again declined and prices regained most of the losses incurred during the first 6 months. At the close of the year the outlook was considerably brighter than at the beginning.

The national defense aspects of minerals received considerable attention during 1938, and legislation authorizing the purchase of war-reserve stock piles of the relatively few minerals that the United States obtains abroad was introduced in Congress. In keeping with its policy of presenting timely and useful information, the Economics and Statistics Branch has summarized the domestic situation on the more important deficient strategic minerals in this issue of the Yearbook.

The Bureau's activity in collecting marketing statistics was extended in 1938. The annual survey of consumption of pig iron and iron and steel scrap, begun in 1935 on a temporary basis, was established permanently as a result of an appropriation granted by Congress in response to requests from industry for continuation of this work. The results of the survey for 1938 are included in a separate chapter entitled "Scrap Iron and Steel" in Minerals Yearbook, 1939. This volume likewise includes for the first time statistics on the sales of barite by consuming industries and a survey of kerosene consumption.

The practice, adopted last year, of issuing the separate chapters of the Yearbook as preprints as soon as they are completed, was well-received by the public and is being continued this year.

JUNE 23, 1939. JOHN W. FINCH, *Director*.

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INTRODUCTION

Despite sharp declines in production of virtually all important minerals the record of the mineral industry in 1938 was better than that of business in general. The index of the Federal Reserve Board for minerals was 98, a drop of 15 percent from 1937, whereas the combined index for all industry was 86, a drop of 22 percent.

The preliminary total value of mineral production in the United States in 1938, as reported to the Bureau of Mines by producers, was $4,354,000,000, a decrease of 20 percent from $5,413,600,000 in 1937. Metals, as a group, showed the sharpest decline—40 percent—followed by mineral fuels, with a drop of over 12 percent and nonmetals with nearly 12 percent.

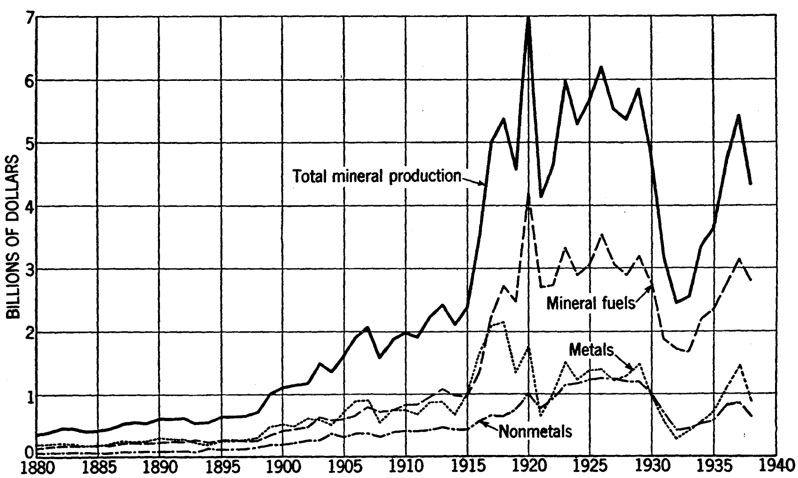

FIGURE 1.—Mineral production of the United States, 1880–1938.

Gold was outstanding among the principal minerals, in that production in 1938 increased appreciably from 1937. Aluminum output was only 2 percent below 1937, but copper, lead, and zinc dropped from a third to a fifth below 1937 levels and, largely as a result of smaller production of base metals, silver output also declined. The depressed condition of the steel industry was responsible for a drop of 61 percent in iron ore production, and most of the other minerals used in steel manufacture—fluorspar, fluxing stone, coke, and alloying metals—showed similar declines. Molybdenum was the notable exception, for production again increased in 1938 although shipments were lower than in 1937.

The relatively mild winter of 1938 as well as low industrial activity resulted in a drop of 23 percent in bituminous coal and lesser declines in output of anthracite, petroleum, and natural gas. Natural gasoline production increased slightly. The output of the building materials group—cement, stone, sand and gravel, gypsum, lime, and clay products—in general was roughly 10 percent lower in 1938 than in 1937, although total slate production was slightly higher owing to increased demand for granules. The conspicuous exception to the general downward trend of the other nonmetals was bromine, production of which again rose to a new record.

Strategic minerals.—The mounting interest in strategic and critical materials culminated early in June 1939 with the passage of an act—

> To provide for the common defense by acquiring stocks of strategic and critical materials essential to the needs of industry for the manufacture of supplies for the armed forces and the civilian population in time of a national emergency, and to encourage, as far as possible, the further development of strategic and critical materials within the United States for common defense.

This act carries authorization for the appropriation of $100,000,000 during 4 fiscal years beginning July 1, 1939, for procuring stock piles of strategic commodities. Obviously, this sum is not adequate to establish emergency supplies of all deficient minerals or other materials, but the legislation marks the first major peacetime effort to meet the strategic-material problem. The bill also authorizes the appropriation of $500,000 annually for 4 years to the Department of the Interior for an investigation of domestic resources of deficient strategic minerals with a view to developing production therefrom. Of the sum authorized, $350,000 is to be expended by the Bureau of Mines and $150,000 by the Geological Survey.

The Army and Navy Munitions Board late in 1938 defined strategic materials as "those essential to the national defense for the supply of which in war dependence must be placed in whole, or in part, on sources outside the continental limits of the United States, and for which strict conservation and distribution control measures will be necessary." Ten of the 17 commodities included on the list of strategic materials are of mineral origin, as follows: Aluminum, antimony, chromium, manganese (ferrograde ore), mica, nickel, quartz crystal, quicksilver, tin, and tungsten.

The Board defined critical materials as "those essential to the national defense, the procurement problems of which in war, while difficult, are less serious than those of strategic materials because they can be either domestically produced or obtained in more adequate quantities or have a lesser degree of essentiality, and for which some degree of conservation and distribution control will be necessary." Nine of the 20 commodities classified as critical materials are of mineral origin, as follows: Asbestos, cadmium, cryolite, fluorspar, graphite, iodine, platinum, titanium, and vanadium.

The Bureau of Mines has occupied an important position in the investigation of the deficient-minerals problem. A member of the staff has served prominently on each of the 17 commodity committees, appointed by the Assistant Secretary of War. John W. Finch, Director of the Bureau, and J. W. Furness, Chief, Economics and Statistics Branch, prepared an analysis of the strategic-mineral problem. They summarized their findings as follows:

> Despite the costly experiences of the World War the industrial preparedness program of the United States still contains a major weakness by reason of its failure to provide adequate supplies of our deficient minerals for use in time of stress. While the situation in some commodities has improved since 1918, it has become more acute in others. The United States is no longer dependent on foreign sources for nitrates, potash, and platinum, for example, and domestic production of a few other commodities has been expanded. On the other hand, exhaustion

of higher grade ore bodies, as in the case of mercury, and the tremendous increase in the use of such essential metals as tin, manganese, chromium, tungsten, and aluminum has increased our dependence on foreign sources of supply for these commodities. Deficient minerals, therefore, still constitute a major problem in national defense.

Two methods of solving this problem have been suggested: The purchase of stock piles of strategic minerals to be held in reserve for military and civilian uses in an emergency, and the stimulation of domestic industries by tariff protection or other subsidies.

Congress adopted the second method in 1922 when it established an import duty on manganese ore, but during 14 years of protection ranging from 50 to 100 percent ad valorem, only 5 percent of our metallurgical requirements were supplied from domestic sources. As a result of this experience with tariff stimulation and the present need for strengthening national defense, the value of the stockpile method is receiving wider recognition. The purchase of a manganese stock pile was advocated in the annual report of the Secretary of War for 1927 and the Naval appropriation bills for the past 2 years have included small sums for the purchase of reserve supplies of strategic minerals.

The Bureau of Mines believes that the purchase of stock piles of standard-grade materials is the first step in providing a safe solution of the deficient-mineral problem and recommends immediate action in this direction. It is realized, however, that it would be impractical to obtain stock piles large enough to safeguard the nation in a prolonged war and for this reason domestic resources must be considered as a supplementary source of supply in emergency. The Bureau recommends, therefore, that a national inventory of domestic deposits be undertaken at once by appropriate government agencies and that a carefully prepared plan be developed for exploiting these deposits in time of need. If adopted, this two-point program will guarantee adequate supplies of essential raw materials and thus assure the completion of the industrial mobilization plans to be inaugurated in the event of war.

It is indeed gratifying that the recommendations of the Bureau have been adopted virtually unchanged in the legislation providing for stock piles. Many of the historical data assembled during this study are included in the chapters of this volume, thereby establishing their permanence for future reference.

Minerals Yearbook series.—Minerals Yearbook, 1939, continues the progress made in Minerals Yearbook, 1938, in presenting final data for the year under review by including complete final statistics for metal mining in Arizona. A new chapter on scrap iron and steel has been added. Only the chapters on bituminous coal, coke, petroleum, natural gas, and natural gasoline are based on preliminary data for 1938.

The practice of issuing preprints of separate chapters in advance of the bound volume was introduced last year. It met with widespread favor and is being continued this year; 48 chapters have been printed and distributed. This procedure was adopted with some misgiving because of its potential lowering effect on sales of the bound volume. This apprehension proved to be unfounded for total circulation of Minerals Yearbook, 1938, was more than 9,000 copies, and the sales edition was exhausted several months before the appearance of the present volume.

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. Although the Coal Commission did not conduct a canvass of production for 1937 comparable to earlier years, the statistical record of the industry, maintained by the Geological Survey and the Bureau of Mines since 1880, remains unbroken for the Commission has prepared a chapter for this volume based on data from various sources. Preliminary data for 1938 also are given. The cooperation of the Coal Commission in contributing this chapter 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 general 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 and advice.

In the collection of mineral statistics in several States the Bureau of Mines receives the formal cooperation of the State geologist or comparable State official. 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 1938 canvass were: Walter B. Jones, State geologist, University, Ala.; Herman Gunter, State geologist, Tallahassee, Fla.; Garland Peyton, director, and Richard W. Smith, geologist, 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.; Charles C. Adams, director, D. H. Newland, State geologist, and C. A. Hartnagel, assistant State geologist, New York State Museum, Albany, N. Y.; 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, 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, and Max Abel assisted in the administrative details of the Yearbook program. 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, was responsible for the editing of the entire manuscript.

H. Herbert Hughes.

June 23, 1939.

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.

CHANGES IN FORM OF PRESENTATION

A change, which it is believed is most desirable, has been made in the first two tables of this summary in the form of presentation. In the first table all minerals produced are listed separately under metallic or nonmetallic, and the entry "Unspecified", given in earlier chapters of this series, has been eliminated. In the second table this change has been carried back through 1880, the first year of record. For years beginning with 1914 the breakdown of "Unspecified" into metallic and nonmetallic has been based on actual figures; prior to 1914 the distribution has been made arbitrarily—divided equally—as no figures are available for closer separation.

Attention is called also to a change in presentation of figures for the clay industry for 1936, 1937, and 1938. As no figures are available for the total clay produced, earlier chapters of this series included in both United States and State totals the total value of clay products and excluded the value of the clay sold as such by producers. The Bureau of Mines, however, believes that a closer approach to the value of domestic clay in its first marketable form will result from the inclusion of the value of clay sold by producers and of clay products other than pottery and refractories. The change has been made in this chapter in the United States totals for 1936 to 1938 and in the State totals for 1936 and 1937. It should be borne in mind when comparing these values with those for earlier years.

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, some by number of "pieces," etc., and 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.

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, 1936–38 [1]

[See second and third paragraphs of this chapter]

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value	1938 Quantity	1938 Value
METALLIC						
Aluminum........pounds	224,929,000	$41,612,000	292,681,000	$55,609,000	286,882,000	$56,659,000
Antimonial lead........short tons (2,000 pounds)	[2] 23,230	(2)	[2] 27,524	(2)	[2] 24,123	(2)
Antimony:						
Metal........do	3,451	(3 4)	4,057	(3 4)	(3 4)	(3 4)
Ore and concentrates........do	3,867	(5)	4,250	137,600	2,730	61,510
Bauxite........long tons (2,240 pounds)	372,005	2,198,523	420,232	2,444,686	311,354	1,812,545
Cadmium........pounds	3,633,495	2,889,000	3,995,739	4,555,000	3,753,323	2,815,000
Chromite........long tons	269	2,978	2,321	14,888	812	10,730
Copper,[6] sales value........pounds	1,222,819,396	112,499,000	1,669,322,278	201,988,000	1,124,656,539	110,216,000
Ferro-alloys........long tons	853,531	69,135,074	970,651	86,140,492	464,112	41,811,513
Gold [7]........troy ounces	4,357,394	152,508,800	4,804,540	168,158,900	5,089,811	178,143,400
Iron:						
Ore [4]........long tons	51,465,648	[4] 131,740,594	72,347,785	[4] 207,828,213	26,430,910	[4] 74,322,405
Pig........do	30,798,958	541,693,504	35,224,347	731,139,435	18,202,354	356,875,369
Lead (refined),[6] sales value........short tons	387,698	35,668,000	443,142	52,291,000	331,964	30,541,000
Magnesium (new ingot)........pounds	3,903,312	(5)	4,539,980	(5)	4,819,617	(5)
Manganese ore (35 percent or more Mn)........long tons	32,119	696,400	40,241	1,062,399	25,321	681,679
Manganiferous ore (5 to 35 percent Mn)........do	940,519	2,235,366	1,340,972	3,857,768	308,860	858,356
Mercury:						
Metal........flasks (76 pounds net)	16,569	1,324,194	16,508	1,488,691	17,991	1,357,781
Ore........short tons	(8)	(9)	(8)	(9)	(8)	(9)
Molybdenum........pounds	17,959,000	11,933,000	30,122,000	20,571,000	25,727,000	17,977,000
Nickel........short tons	107	(5)	219	(5)	416	(5)
Ores (crude), old tailings, etc.:						
Copper........do	38,505,000	(9)	61,640,000	(9)	(10)	(9)
Dry and siliceous (gold and silver)........do	16,949,000	(9)	17,355,000	(9)	(10)	(9)
Lead........do	3,898,000	(9)	5,670,000	(9)	(10)	(9)
Lead-copper........do	2,000	(9)	2,000	(9)	(10)	(9)
Zinc........do	11,098,000	(9)	12,693,000	(9)	(10)	(9)
Zinc-lead........do	8,889,000	(9)	10,651,000	(9)	(10)	(9)
Zinc-lead-copper........do	73,000	(9)	----------	----------	(10)	(9)
Platinum and allied metals (value at New York City)..troy ounces	46,946	1,968,000	45,258	2,114,000	36,213	1,263,000
Selenium........pounds	226,402	(5)	282,598	(5)	166,494	(5)
Silver [11]........troy ounces	63,812,176	49,422,530	71,941,794	55,646,978	62,665,335	40,510,924
Tantalum ore........pounds	----------	----------	16,307	13,317	36,189	35,127
Tellurium........do	25,453	(5)	23,365	(5)	26,944	(5)
Tin (metallic equivalent)........short tons	113	105,000	189	205,300	122	103,200

See footnotes at end of table.

Mineral products of the United States, 1936–38—Continued

Product	1936		1937		1938	
	Quantity	Value	Quantity	Value	Quantity	Value
METALLIC—continued						
Titanium ore:						
Ilmenite short tons	(5)	(5)	(5)	(5)	(5)	(5)
Rutile do	(5)	(5)	(5)	(5)	(5)	(5)
Tungsten ore (60-percent concentrates) do	2,612	$2,323,818	3,500	$4,094,000	3,044	$3,161,498
Uranium and vanadium ores do	75,738	(5)	131,080	(5)	231,687	898,779
Zinc,[6] sales value do	491,803	49,180,000	551,165	71,651,000	436,007	41,857,000
Other metallic[12]		1,114,037		852,105		907,612
Total value of metallic products (approximate)		1,081,600,000		1,468,200,000		891,800,000
NONMETALLIC						
Arsenious oxide short tons	15,581	618,826	17,636	541,555	13,160	393,022
Asbestos do	11,064	314,161	12,079	344,644	10,440	247,264
Asphalt:						
Native do	581,064	3,260,895	485,384	3,019,038	512,147	3,065,260
Oil (including road oil)[4] do	3,607,603	[4] 31,790,935	3,844,326	[4] 36,670,827	4,249,226	[4] 34,572,918
Barite (crude) do	283,160	1,674,631	355,888	2,240,970	309,663	2,004,521
Borates (naturally occurring sodium borates and colemanite (calcium borate)) short tons	313,759	6,156,123	358,898	7,232,897	219,513	4,570,316
Bromine pounds	20,609,025	4,038,438	26,200,256	5,180,177	32,324,116	6,610,056
Calcium-magnesium chloride short tons	125,911	1,909,908	101,547	1,295,403	103,930	1,218,938
Cement barrels (376 pounds net)	114,610,972	172,777,698	115,678,182	171,414,093	108,069,668	156,535,303
Clay:						
Products (other than pottery and refractories)[13]		95,136,775		109,175,963		(13)
Raw (sold by producers) short tons	3,782,428	13,423,456	4,237,386	15,708,064	2,730,861	11,775,572
Coal:						
Bituminous[14] do	[15] 439,087,903	[15] 770,955,000	[15] 445,531,449	[16] 864,042,000	[15] 344,630,000	[16] 655,000,000
Pennsylvania anthracite do	54,579,535	227,003,538	51,856,433	197,598,849	46,099,027	180,600,167
Coke[4] do	46,275,184	[4] 232,373,991	52,375,469	[4] 261,003,903	32,633,304	([4] [10])
Diatomite do	(17)	(17)	(17)	(17)	(17)	(17)
Emery do	325	2,900	320	2,780		
Feldspar (crude) long tons	244,726	1,303,090	268,532	1,383,249	196,119	895,081
Fluorspar short tons	176,877	3,119,668	181,230	3,666,629	80,403	1,599,666
Fuller's earth do	230,814	2,264,978	226,165	2,296,094	170,852	1,707,869
Garnet for abrasive purposes do	3,820	315,913	4,863	382,535	2,669	191,658
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	13,175	497,997	14,541	572,708	6,206	240,006

Gypsum ... do	[19] 2,712,510	[19] 26,222,377	[20] 3,058,166	[20] 4,782,503	[20] 2,684,205	[20] 4,271,674
Helium ... cubic feet	(21)	(21)	(21)	(21)	(21)	(21)
Iodine ... pounds	233,925	212,635	299,286	242,422	(17)	(17)
Kyanite ... short tons	(8)	(8)	(8)	(8)	(8)	(8)
Lime ... do	3,749,383	26,933,719	4,124,165	30,091,168	3,346,954	24,137,638
Lithium minerals ... do	1,241	34,273	1,357	36,206	892	329,088
Magnesite (crude) ... do	207,119	1,411,664	203,437	1,483,492	97,000	725,000
Magnesium oxide (hydrated) (brucite) ... do	(17)	(17)	(17)	(17)	141,465,613	1,688,570
Magnesium salts (natural) ... pounds	127,682,793	1,629,725	129,553,918	1,578,527		
Marl:						
Calcareous ... short tons	45,528	58,682	46,650	59,775	23,572	40,270
Greensand ... do	8,368	177,835	9,734	210,974	6,576	152,000
Mica:						
Scrap ... do	20,955	260,594	25,196	354,737	20,257	256,382
Sheet ... pounds	1,319,233	203,879	1,694,538	285,244	939,507	139,333
Millstones	----------	10,609	----------	8,305	----------	3,743
Mineral paints:						
Cadmium compounds [22] ... pounds	(8)	906,000	(8)	1,441,000	(8)	710,000
Natural pigments [23] ... short tons	(23)	(23)	(23)	(23)	(23)	(23)
Zinc and lead pigments [24] ... do	175,734	15,850,829	163,617	17,088,595	123,146	13,969,840
Mineral waters ... gallons sold	(18)	(18)	(18)	(18)	(18)	(18)
Natural gas ... M cubic feet	2,167,802,000	476,813,000	2,407,620,000	528,354,000	2,263,000,000	500,870,000
Natural gasoline ... gallons	1,796,340,000	84,572,000	2,065,434,000	97,125,000	2,113,314,000	78,195,000
Oilstones, etc. ... short tons	752	121,196	810	112,841	511	130,277
Olivine ... do	(8)	(8)	(8)	(8)	(8)	(8)
Peat ... do	46,126	266,883	51,223	305,156	45,933	286,127
Petroleum ... barrels (42 gallons)	1,099,687,000	1,199,820,000	1,279,160,000	1,513,340,000	1,213,254,000	1,390,000,000
Phosphate rock ... long tons	3,351,857	11,406,132	3,956,189	12,975,268	3,739,238	12,952,143
Potassium salts ... short tons	[25] 222,810	6,969,190	[25] 266,938	9,019,534	[25] 286,437	9,748,290
Pumice ... do	72,915	328,406	71,007	301,936	65,742	312,886
Pyrites ... long tons	547,236	1,666,194	584,166	1,777,787	555,629	1,685,766
Salt (sodium chloride) ... short tons	8,828,936	23,306,177	9,241,564	24,131,733	8,025,768	23,242,561
Sand and gravel:						
Glass sand ... do	2,394,710	4,050,749	2,799,230	4,746,629	2,109,462	3,601,734
Sand (molding, building, etc.) and gravel ... do	175,935,104	86,257,003	186,861,193	92,726,368	179,210,771	82,321,113
Sand-lime brick [13] ... thousands	103,189	922,662	135,005	1,190,773	(13)	(13)
Silica (quartz) ... short tons	12,986	96,592	13,012	66,041	18,611	88,197
Slate ... do	454,760	5,485,208	444,560	5,605,322	492,690	5,655,313
Sodium salts (carbonates and sulfates) (natural) ... do	154,474	1,442,923	184,764	1,790,751	180,220	1,832,140
Stone [26] ... do	131,416,420	141,525,979	133,143,240	146,213,128	124,838,940	139,255,046
Sulfur ... long tons	1,968,820	35,400,000	2,466,512	44,300,000	1,628,847	27,300,000
Sulfuric acid (60° Baumé) (byproduct) [27] ... short tons	732,620	5,741,143	833,994	6,735,194	(28)	(28)
Talc, pyrophyllite, and ground soapstone [26] ... do	216,191	2,343,171	229,999	2,561,753	212,775	2,302,560
Tripoli ... do	28,487	391,878	34,936	450,570	22,188	329,081
Vermiculite ... do	16,933	185,787	26,556	260,664	20,700	192,000
Other nonmetallic [29]	----------	2,802,781	----------	2,647,381	----------	1,848,890
Total value of nonmetallic products (approximate)	----------	3,475,200,000	----------	3,945,400,000	----------	3,462,200,000

See footnotes at end of table.

Mineral products of the United States, 1936–38—Continued

Product	1936		1937		1938	
	Quantity	Value	Quantity	Value	Quantity	Value
SUMMARY						
Total value:						
Metallic		$1,081,600,000		$1,468,200,000		$891,800,000
Nonmetallic:						
Fuels		2,759,200,000		3,200,500,000		2,804,700,000
Other		716,000,000		744,900,000		657,500,000
Grand total approximate value of mineral products		4,556,800,000		5,413,600,000		4,354,000,000

1 In this general statement certain of the figures represent shipments rather than quantity mined, and some of the figures for 1938 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 Value included in total value of metallic products; Bureau of Mines not at liberty to publish figures.

6 Product from domestic ores only.

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

8 Figures not available.

9 Figures showing values not available.

10 Figures for 1938 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.

1936: Bismuth, iron ore sold for magnets (5 long tons), and iron ore sold for paint (10,348 long tons, valued at $53,037).

1937: Bismuth, iron ore sold for magnets (2 long tons), and iron ore soldf or 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).

13 Figures obtained through cooperation with Bureau of the Census. Figures for 1938 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 National Bituminous Coal Commission.

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 Gypsum mined; value as sold (crude and calcined). Comparable value for later years not available.

20 Gypsum mined; value of crude at mine as reported by producers. Comparable value for years prior to 1937 not available.

21 Value included in total value of nonmetallic products. For details of production in fiscal years see chapters on Helium.

22 Largely for use in manufacture of pigments. Figures for quantity of pigment not available.

23 Canvass discontinued after 1915. Figures for iron ore sold for paint given in footnote 12.

24 Sublimed blue lead, sublimed white lead, leaded zinc oxide, and zinc oxide.

25 Equivalent as K_2O.

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

27 From copper and zinc smelters and zinc roasters and from roasting of high-sulfide gold and silver concentrates.

28 Figures not yet available; estimate of value included in total value of nonmetallic products.

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

1936: Chats (3,919,300 short tons, valued at $666,000), flint lining for tube mills, pebbles for grinding, silica sand and sandstone (finely ground) (354,505 short tons, $2,121,785), and sulfur ore (13 long tons).

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 (finely 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 (finely ground) (237,167 short tons, $1,425,445).

Value of mineral products of the United States, 1880–1938 [1]

[See second and third paragraphs of this chapter]

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	744,900,000	3,945,400,000	5,413,600,000
1938 [3]	891,800,000	2,804,700,000	657,500,000	3,462,200,000	4,354,000,000
Grand total	43,440,027,000	77,939,052,000	27,089,510,000	105,028,562,000	148,468,589,000

[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, 1933–37, by States

[See second and third paragraphs of this chapter]

State	1933	1934	1935	1936	1937
Alabama	$23, 291, 204	$29, 827, 048	$31, 772, 042	$44, 752, 688	$53, 518, 993
Alaska	12, 681, 071	19, 578, 971	18, 811, 544	23, 737, 714	27, 927, 958
Arizona	12, 570, 753	26, 062, 865	38, 848, 203	60, 532, 996	94, 564, 494
Arkansas	12, 710, 203	16, 081, 642	17, 608, 569	21, 296, 783	25, 578, 393
California	293, 034, 859	331, 255, 652	360, 178, 680	437, 565, 809	476, 974, 925
Colorado	27, 259, 095	39, 473, 123	44, 413, 477	56, 214, 827	67, 338, 548
Connecticut	1, 550, 594	2, 276, 061	2, 656, 207	3, 317, 494	3, 689, 554
Delaware	135, 397	271, 814	229, 904	444, 093	397, 362
District of Columbia	423, 233	406, 891	479, 256	547, 576	522, 687
Florida	8, 843, 896	11, 548, 144	11, 447, 052	12, 973, 243	13, 811, 958
Georgia	7, 529, 321	7, 986, 388	9, 803, 955	11, 756, 592	12, 584, 060
Idaho	12, 429, 155	16, 708, 153	21, 364, 029	29, 965, 964	40, 633, 119
Illinois	74, 837, 452	89, 213, 596	96, 483, 558	117, 916, 128	133, 437, 554
Indiana	34, 010, 753	39, 416, 727	42, 512, 613	52, 281, 539	54, 886, 756
Iowa	15, 154, 652	19, 326, 181	21, 709, 817	28, 359, 140	26, 941, 350
Kansas	57, 974, 881	81, 117, 503	96, 905, 947	121, 689, 562	154, 376, 403
Kentucky	65, 536, 454	89, 042, 117	98, 486, 090	113, 435, 307	127, 423, 680
Louisiana	54, 886, 010	85, 210, 783	107, 544, 710	153, 358, 397	182, 118, 905
Maine	2, 593, 871	2, 352, 076	2, 559, 648	3, 423, 353	4, 129, 391
Maryland	7, 014, 570	10, 128, 349	10, 035, 751	11, 157, 550	10, 634, 854
Massachusetts	4, 917, 110	6, 165, 303	5, 650, 148	7, 559, 253	7, 813, 345
Michigan	54, 222, 848	61, 831, 364	77, 149, 256	100, 646, 492	119, 167, 573
Minnesota	42, 472, 038	48, 328, 235	57, 313, 256	94, 568, 991	152, 107, 070
Mississippi	2, 765, 988	2, 520, 521	3, 092, 609	3, 846, 104	4, 821, 950
Missouri	30, 588, 018	32, 954, 534	35, 800, 213	41, 350, 860	52, 446, 272
Montana	21, 662, 089	31, 430, 496	52, 096, 553	65, 569, 150	82, 086, 815
Nebraska	2, 047, 335	2, 790, 571	3, 228, 856	3, 843, 562	4, 837, 809
Nevada	7, 455, 493	14, 702, 869	20, 987, 749	32, 693, 129	38, 871, 816
New Hampshire	1, 457, 041	1, 149, 289	693, 988	1, 182, 055	1, 219, 869
New Jersey	22, 580, 043	25, 009, 596	28, 514, 673	24, 421, 046	31, 467, 931
New Mexico	23, 354, 681	30, 079, 469	33, 502, 362	45, 942, 006	72, 855, 745
New York	42, 940, 471	54, 625, 552	58, 408, 999	71, 647, 775	77, 665, 874
North Carolina	3, 365, 160	5, 342, 306	6, 774, 649	9, 955, 519	11, 160, 444
North Dakota	2, 960, 811	2, 549, 850	2, 543, 910	2, 902, 453	2, 873, 011
Ohio	91, 145, 609	117, 504, 662	126, 133, 670	122, 684, 043	131, 025, 104
Oklahoma	172, 560, 924	237, 208, 583	251, 700, 898	305, 191, 649	367, 444, 222
Oregon	3, 504, 825	4, 211, 397	5, 596, 484	7, 080, 975	6, 609, 710
Pennsylvania	421, 846, 539	546, 932, 552	520, 575, 611	599, 457, 486	599, 817, 364
Rhode Island	386, 983	485, 441	570, 520	929, 103	862, 710
South Carolina	1, 014, 162	1, 323, 293	1, 843, 476	3, 432, 662	4, 022, 325
South Dakota	14, 658, 504	19, 173, 033	22, 209, 554	23, 221, 620	23, 472, 873
Tennessee	16, 785, 481	23, 525, 650	25, 743, 471	31, 121, 865	34, 893, 847
Texas	365, 571, 179	509, 521, 286	528, 069, 238	638, 643, 488	813, 270, 605
Utah	24, 179, 771	32, 527, 119	41, 933, 136	61, 209, 302	105, 652, 422
Vermont	5, 792, 574	4, 852, 949	5, 097, 295	6, 225, 396	7, 042, 547
Virginia	18, 845, 740	28, 309, 377	30, 923, 115	37, 295, 168	46, 019, 085
Washington	9, 387, 645	12, 944, 751	13, 688, 083	22, 921, 456	26, 658, 257
West Virginia	172, 726, 695	241, 473, 621	245, 402, 124	271, 501, 941	306, 660, 947
Wisconsin	7, 153, 881	9, 752, 431	11, 817, 933	13, 277, 983	15, 228, 024
Wyoming	22, 025, 393	27, 640, 294	30, 669, 658	34, 498, 261	41, 087, 908

Mineral products of the United States and principal producing States in 1937

[See second and third paragraphs of this chapter]

Rank in value	Product	Principal producing States [1] — In order of quantity	Principal producing States [1] — In order of value
17	Aluminum	New York, Tennessee, North Carolina	Rank same as for quantity.
(2)	Antimonial lead	Not separable by States	Not separable by States.
76	Antimony ore	Idaho, Alaska, Nevada, Washington	Alaska, Idaho, Nevada, California.
62	Arsenious oxide	Montana, Utah, Idaho	Rank same as for quantity.
67	Asbestos	Vermont, Arizona, Maryland, North Carolina	Do.
	Asphalt:		
38	Native	Oklahoma, Kentucky, Texas, Alabama	Utah, Kentucky, Oklahoma, Texas.
20	Oil	Not separable by States	Not separable by States.
42	Barite (crude)	Missouri, Georgia, Tennessee, California	Rank same as for quantity.
40	Bauxite	Arkansas, Alabama, Georgia	Do.
57	Bismuth	Not separable by States	Not separable by States.
90	Bitumen (natural sulfonated)	Utah	Rank same as for quantity.
29	Borates	California	Do.
32	Bromine	Michigan, North Carolina, West Virginia, California	Do.
34	Cadmium	Not separable by States	Not separable by States.
50	Cadmium compounds	do	Do.
52	Calcium-magnesium chloride	Michigan, West Virginia, Ohio	Rank same as for quantity.
8	Cement	Pennsylvania, California, Michigan, Texas	Pennsylvania, California, Texas, Michigan.
59	Chats	Oklahoma, Missouri, Kansas	Rank same as for quantity.
86	Chromite	California, Oregon	Do.
	Clay:		
11	Products (other than pottery and refractories).		Ohio, Pennsylvania, California, Illinois.
25	Raw (sold by producers)	Pennsylvania, Missouri, Georgia, Ohio	Georgia, Pennsylvania, Missouri, Kentucky.
2	Coal:		
	Bituminous	West Virginia, Pennsylvania, Illinois, Kentucky	Pennsylvania, West Virginia, Illinois, Kentucky.
	Pennsylvania anthracite	Pennsylvania	Rank same as for quantity.
5	Coke	Pennsylvania, Ohio, Indiana, New York	Pennsylvania, Indiana, Ohio, New York.
7	Copper	Arizona, Utah, Montana, Nevada	Rank same as for quantity.
46	Diatomite	California, Oregon, Washington, New Jersey	Do.
92	Emery	New York	Do.
51	Feldspar (crude)	North Carolina, Colorado, South Dakota, New Hampshire	Do.
14	Ferro-alloys	Pennsylvania, New York, Ohio, West Virginia	Pennsylvania, New York, West Virginia, Ohio.
85	Flint lining for tube mills	Minnesota	Rank same as for quantity.
37	Fluorspar	Kentucky, Illinois, Colorado, New Mexico	Illinois, Kentucky, Colorado, New Mexico.
41	Fuller's earth	Georgia, Florida, Texas, Illinois	Rank same as for quantity.
65	Garnet (abrasive)	New York, New Hampshire, North Carolina	Do.
(3)	Gems and precious stones	No canvass for 1937	No canvass for 1937.
9	Gold	California, Alaska, South Dakota, Colorado	Rank same as for quantity.

88	Graphite:		
	Amorphous	Nevada, Michigan	Do.
	Crystalline	Texas, Montana	Montana, Texas.
61	Grindstones and pulpstones	Ohio, West Virginia, Washington	Rank same as for quantity.
33	Gypsum (crude)	New York, Michigan, Iowa, Texas	New York, Michigan, Iowa, Virginia.
80	Helium	Texas	Rank same as for quantity.
72	Iodine (natural)	California	Do.
	Iron:		
6	Ore	Minnesota, Michigan, Alabama, Pennsylvania	Minnesota, Michigan, Alabama, Wisconsin.
3	Pig	Pennsylvania, Ohio, Indiana, Illinois	Rank same as for quantity.
56	Sinter	Tennessee	Do.
([4])	Kyanite	No figures available	No figures available.
18	Lead	Missouri, Idaho, Utah, Oklahoma	Rank same as for quantity.
21	Lime	Ohio, Pennsylvania, Missouri, West Virginia	Do.
82	Lithium minerals	South Dakota	Do.
49	Magnesite (crude)	Washington, California	Do.
55	Magnesium	Michigan	Do.
84	Magnesium hydrate (brucite)	Nevada	Do.
47	Magnesium salts (natural)	Michigan, California, Washington, West Virginia	Do.
54	Manganese ore	Montana, Arkansas, Tennessee, Virginia	Montana, Tennessee, Arkansas, Virginia.
36	Manganiferous ore	Minnesota, Montana, New Mexico, Colorado	Rank same as for quantity.
71	Manganiferous zinc residuum	New Jersey	Do.
	Marl:		
79	Calcareous	West Virginia, Wisconsin, Virginia, North Carolina	West Virginia, North Carolina, Virginia, Nevada.
73	Greensand	New Jersey	Rank same as for quantity.
48	Mercury	California, Oregon, Texas, Arkansas	Do.
58	Mica	North Carolina, Georgia, California, Virginia	North Carolina, Georgia, Connecticut, Virginia.
	Scrap	do	North Carolina, Georgia, Virginia, California.
	Sheet	North Carolina, Connecticut, New Hampshire, Virginia	North Carolina, Connecticut, New Hampshire, New Mexico.
89	Millstones		New York, Virginia.
24	Mineral paints (zinc and lead pigments).	Pennsylvania, Kansas, Illinois, Ohio	Rank same as for quantity.
([3])	Mineral waters	No canvass for 1937	No canvass for 1937.
23	Molybdenum	Colorado, Utah, Arizona, New Mexico	Rank same as for quantity.
4	Natural gas	Texas, California, Louisiana, Oklahoma	Texas, California, West Virginia, Louisiana.
13	Natural gasoline	California, Texas, Oklahoma, Louisiana	Rank same as for quantity.
75	Nickel	Not separable by States	Not separable by States.
77	Oilstones, etc	New Hampshire, Ohio, Indiana, Arkansas	Arkansas, Ohio, Indiana, New Hampshire.
([4])	Olivine	No figures available	No figures available.
([5])	Ores (crude), etc.:		
	Copper	Utah, Arizona, Nevada, Michigan	Value not available.
	Dry and siliceous (gold and silver)	Alaska, California, Nevada, Colorado	Do.
	Lead	Missouri, Idaho, Utah, Colorado	Do.
	Lead-copper	Nevada, Colorado, New Mexico, Arizona	Do.
	Zinc	Oklahoma, Kansas, Tennessee, New Jersey	Do.
	Zinc-lead	Oklahoma, Kansas, Idaho, Utah	Do.
68	Peat	New Jersey, New York, Florida, Michigan	Florida, New Jersey, Michigan, Ohio.

[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 1937.
[4] No figures available.
[5] Value not available.

Mineral products of the United States and principal producing States in 1937—Continued

Rank in value	Product	Principal producing States — In order of quantity	Principal producing States — In order of value
91	Pebbles for grinding	Minnesota	Rank same as for quantity.
1	Petroleum	Texas, California, Oklahoma, Louisiana	Texas, Oklahoma, California, Louisiana.
26	Phosphate rock	Florida, Tennessee, Idaho, Montana	Rank same as for quantity.
43	Platinum and allied metals	Alaska, California, Oregon	Do.
28	Potassium salts	New Mexico, California, Maryland, Utah	Do.
69	Pumice	Kansas, California, Nebraska, Oklahoma	California, Kansas, Nebraska, Oklahoma.
45	Pyrites	Tennessee, Virginia, New York, California	Rank same as for quantity.
22	Salt	Michigan, New York, Ohio, Louisiana	Michigan, New York, Louisiana, Kansas.
12	Sand and gravel	Illinois, California, New York, Michigan	Pennsylvania, Illinois, Washington, California.
53	Sand-lime brick	New York, Massachusetts, Minnesota, Michigan	New York, Massachusetts, Michigan, Minnesota.
63	Selenium	Not separable by States	Not separable by States.
78	Silica (quartz)	Ohio, Tennessee, North Carolina, California	Rank same as for quantity.
44	Silica sand and sandstone (finely ground).	Illinois, New Jersey, Pennsylvania, Ohio	Illinois, New Jersey, Ohio, West Virginia.
16	Silver	Idaho, Utah, Montana, Arizona	Rank same as for quantity.
31	Slate		Pennsylvania, Vermont, Maine, New York.
27	Sodium salts (other than NaCl) (natural).	California, Texas, Wyoming	Rank same as for quantity.
10	Stone	Pennsylvania, Michigan, New York, Ohio	Pennsylvania, New York, Ohio, Illinois.
19	Sulfur	Texas, Louisiana, California, Utah	Rank same as for quantity.
30	Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania, Tennessee, Illinois, Arizona	Pennsylvania, Illinois, Tennessee, Arizona.
93	Sulfur ore	Nevada, Colorado	Rank same as for quantity.
39	Talc and ground soapstone[6]	New York, Vermont, California, North Carolina	New York, California, Vermont, North Carolina.
87	Tantalum ore	South Dakota, North Carolina, New Mexico, Colorado	Rank same as for quantity.
83	Tellurium	Not separable by States	Not separable by States.
74	Tin	Alaska, Wyoming, South Dakota, South Carolina	Rank same as for quantity.
	Titanium ore:		
81	Ilmenite	Virginia	Do.
66	Rutile	Virginia, Arkansas	Do.
64	Tripoli	Missouri, Illinois, Oklahoma, Arkansas	Do.
35	Tungsten ore	Nevada, California, Arizona, Colorado	Do.
60	Uranium and vanadium ores	Arizona, Colorado, Utah	Colorado, Arizona, Utah.
70	Vermiculite	Montana, Colorado, Wyoming	Rank same as for quantity.
15	Zinc	Oklahoma, New Jersey, Kansas, Idaho	Do.

[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 1937 [1]

[See second and third paragraphs of this chapter]

State	Rank	Principal mineral products in order of value
Alabama	20	Coal, iron ore, cement, clay products.
Alaska	28	Gold, copper, coal, silver.
Arizona	14	Copper, gold, silver, lead.
Arkansas	31	Petroleum, coal, bauxite, natural gas.
California	3	Petroleum, natural gas, gold, natural gasoline.
Colorado	18	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, stone, cement, sand and gravel.
Georgia	35	Stone, raw clay, clay products, cement.
Idaho	24	Silver, lead, zinc, gold.
Illinois	9	Coal, petroleum, stone, sand and gravel.
Indiana	19	Coal, cement, stone, clay products.
Iowa	29	Do.
Kansas	7	Petroleum, natural gas, zinc, coal.
Kentucky	11	Coal, natural gas, petroleum, stone.
Louisiana	6	Petroleum, natural gas, sulfur, natural gasoline.
Maine	43	Stone, sand and gravel, cement, slate.
Maryland	37	Coal, sand and gravel, cement, clay products.
Massachusetts	38	Stone, sand and gravel, lime, clay products.
Michigan	12	Iron ore, petroleum, copper, cement.
Minnesota	8	Iron ore, manganiferous ore, stone, sand and gravel.
Mississippi	42	Natural gas, sand and gravel, clay products, raw clay.
Missouri	21	Lead, coal, cement, stone.
Montana	15	Copper, silver, petroleum, gold.
Nebraska	41	Cement, stone, sand and gravel, clay products.
Nevada	25	Copper, gold, silver, tungsten ore.
New Hampshire	47	Stone, clay products, sand and gravel, feldspar.
New Jersey	27	Zinc, clay products, sand and gravel, stone.
New Mexico	17	Petroleum, copper, natural gas, potassium salts.
New York	16	Petroleum, natural gas, stone, cement.
North Carolina	36	Stone, clay products, bromine, sand and gravel.
North Dakota	46	Coal, sand and gravel, clay products, stone.
Ohio	10	Coal, clay products, natural gas, stone.
Oklahoma	4	Petroleum, natural gas, natural gasoline, zinc.
Oregon	40	Gold, stone, cement, sand and gravel.
Pennsylvania	2	Coal, petroleum, natural gas, cement.
Rhode Island	48	Stone, sand and gravel, clay products, lime.
South Carolina	44	Stone, clay products, raw clay, sand and gravel.
South Dakota	32	Gold, stone, cement, sand and gravel.
Tennessee	26	Coal, cement, stone, zinc.
Texas	1	Petroleum, natural gas, sulfur, natural gasoline.
Utah	13	Copper, gold, lead, silver.
Vermont	39	Stone, slate, lime, talc.
Virginia	22	Coal, stone, zinc, clay products.
Washington	30	Sand and gravel, coal, cement, stone.
West Virginia	5	Coal, natural gas, petroleum, stone.
Wisconsin	33	Iron ore, stone, sand and gravel, 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, 1933–38 [1]

Year	Gold [2]	Silver [3]	Copper [4]	Lead [4]	Zinc [4]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1933	$25.56	$0.350	$0.064	$0.037	$0.042
1934	34.95	[5] .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	[5] .646+	.098	.046	.048

[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] 1933–34: Yearly average weighted Government price; 1935–38: Price under authority of Gold Reserve Act of Jan. 31, 1934.

[3] 1933: Average New York price for bar silver; 1934 and 1938: 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] $0.64646464.

STATE TABLES

[See second and third paragraphs of this chapter]

Mineral production of Alabama, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Bauxite long tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 3,823,246	[2] $5,597,211	[2] 4,403,459	[2] $6,165,974
Clay:				
Products (other than pottery and refractories)		[3] 1,818,513		[3] 2,077,606
Raw (sold by producers) short tons	79,365	93,157	76,584	99,730
Coal do	[4] 12,229,287	[4] 26,046,000	[4] 12,440,322	[5] 29,857,000
Coke do	3,089,622	[6] 8,774,694	4,259,771	[6] 13,275,098
Copper pounds	14,000	1,288	7,000	847
Ferro-alloys long tons	27,931	[6] 1,697,712	20,470	[6] 1,455,967
Gold troy ounces	4,726	165,410	2,460	86,096
Iron:				
Ore long tons	4,259,804	6,838,016	6,350,316	10,747,967
Pig do	2,061,534	[6] 30,942,051	2,528,785	[6] 42,188,993
Lime short tons	177,582	1,034,110	176,085	964,400
Manganese ore long tons	572	9,558	289	8,448
Manganiferous ore do	540	5,132	428	2,884
Mica, sheet pounds	(1)	(1)		
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Ore (dry and siliceous) (gold and silver) short tons	30,829	(8)	20,173	(8)
Sand and gravel do	1,259,344	507,257	1,489,131	695,858
Silver troy ounces	869	673	457	353
Stone short tons	[9] 1,234,490	[9] 1,675,428	[9] 1,500,860	[9] 1,573,890
Miscellaneous [10]		960,935		1,237,940
Total value, eliminating duplications		44,752,688		53,518,993

[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 National Bituminous Coal Commission.
[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 granite in 1936 and of dimension limestone in 1937, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1", "2", and "9" above.

Mineral production of Alaska, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Antimony ore (concentrates) short tons			(1)	(1)
Arsenic do	(2)	(2)	(2)	(2)
Coal do	[3] 136,593	[3] $574,000	[4] 131,600	[4] $552,700
Copper pounds	37,700,000	3,468,400	34,672,000	4,195,312
Gold troy ounces	540,580	18,920,300	627,940	21,977,900
Lead short tons	941	86,572	823	97,114
Ores (crude), etc.:				
Copper do	143,132	(5)	139,279	(5)
Dry and siliceous (gold and silver) do	4,466,644	(5)	4,580,923	(5)
Lead do	3	(5)		
Platinum and allied metals troy ounces	2,740	130,793	5,431	313,367
Sand and gravel short tons	(1)	(1)	(1)	(1)
Silver troy ounces	484,306	375,095	494,340	382,372
Stone short tons	21,970	31,747	[6] 38,450	[6] 59,845
Tin (metallic equivalent) do	113	105,000	186	202,300
Miscellaneous		45,807		147,048
Total value, eliminating duplications		23,737,714		27,927,958

[1] Value included under "Miscellaneous."
[2] Figures not available.
[3] According to National Bituminous Coal Commission.
[4] According to the Alaskan Branch of the Geological Survey.
[5] Not valued as ore; value of recoverable metal content included under the metals.
[6] Exclusive of dimension unclassified stone, value for which is included under "Miscellaneous."

Mineral production of Arizona, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Asbestos short tons	464	$41,780	648	$76,059
Clay:				
Products (other than pottery and refractories)		[1] 157,178		[1] 209,631
Raw (sold by producers) short tons	(2)	(2)	(2)	(2)
Coal do	(2 3)	(2 3)	(2 3)	(2 4)
Copper pounds	422,550,000	38,874,600	576,956,000	69,811,676
Feldspar (crude) long tons	(2)	(2)	(2)	(2)
Fluorspar short tons	40	(2)	610	(2)
Gems and precious stones		(5)		(5)
Gold troy ounces	322,408	11,284,287	332,694	11,644,290
Gypsum short tons	(2 6)	(2 6)	(2 7)	(2 7)
Lead do	10,688	983,296	12,354	1,457,772
Lime do	25,922	249,560	54,789	466,098
Mercury flasks (76 pounds)	(2)	(2)	37	3,337
Mica, scrap short tons	(2)	(2)	(2)	(2)
Molybdenum pounds	1,461,908	(2)	1,173,942	(2)
Ores (crude), etc.:				
Copper short tons	12,829,873	(8)	19,928,824	(8)
Dry and siliceous (gold and silver) do	809,341	(8)	804,949	(8)
Lead do	25,933	(8)	29,969	(8)
Lead-copper do	228	(8)	59	(8)
Zinc do			91	(8)
Zinc-lead do	154,463	(8)	212,467	(8)
Sand and gravel do	425,289	120,258	1,266,686	632,354
Sand-lime brick thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz) short tons	(2)	(2)	(2)	(2)
Silver troy ounces	8,386,043	6,494,990	9,422,552	7,288,344
Stone short tons	[9] 252,140	[9] 298,943	754,170	983,073
Sulfuric acid [10] do	(2 11)	(2 11)	(2 11)	(2 11)
Tungsten ore (60-percent concentrates) do	489	410,934	349	(2)
Vanadium ores do	(2)	(2)	(2)	(2)
Zinc do	3,589	358,900	5,026	653,380
Miscellaneous [12]		1,773,359		1,878,418
Total value, eliminating duplications		60,532,996		94,564,494

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value included under "Miscellaneous."
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; valueof crude at mine as reported by producers. Comparable value for earlier years 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] From copper smelting.
[11] Value not included in total value for State.
[12] Includes minerals indicated by "2" and "9" above.

Mineral production of Arkansas, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Bauxite ... long tons	354,943	$2,089,196	402,195	$2,322,861
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 800,851		[2] 729,920
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	[3] 1,622,787	[3] 5,064,000	[3] 1,510,753	[4] 5,333,000
Gems and precious stones		(5)		(5)
Iron ore sold for magnets ... long tons	5	(1)	2	(1)
Lead ... short tons	24	2,208	40	4,720
Lime ... do	(1)	(1)	(1)	(1)
Manganese ore ... long tons	4,557	(1)	3,931	(1)
Manganiferous ore ... do	3,285	(1)	7,509	(1)
Mercury ... flasks (76 pounds)	(1)	(1)	(1)	(1)
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Natural gas ... M cubic feet	8,500,000	1,804,000	9,690,000	1,984,000
Natural gasoline ... gallons	11,957,000	541,000	11,285,000	577,000
Oilstones ... short tons	119	64,817	47	44,465
Ores (crude), etc.:				
Lead ... do	(6)	(7)	(6)	(7)
Zinc ... do	(6)	(7)	(6)	(7)
Petroleum ... barrels	10,469,000	8,160,000	11,764,000	11,400,000
Sand and gravel ... short tons	1,068,224	565,478	3,370,634	757,162
Slate		(1)		(1)
Stone ... short tons	521,760	533,177	476,370	485,685
Titanium minerals: Rutile ... do	(1)	(1)	(1)	(1)
Tripoli ... do	(1)	(1)	(1)	(1)
Zinc ... do	182	18,200	241	31,330
Miscellaneous [8]		1,653,856		1,908,250
Total value, eliminating duplications		21,296,783		25,578,393

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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 California, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Antimony ore ... short tons			15	(1)
Asphalt (native) ... do	(1)	(1)	(1)	(1)
Barite ... do	(1)	(1)	(1)	(1)
Borates ... do	313,759	$6,156,123	358,898	$7,232,897
Bromine ... pounds	(1)	(1)	(1)	(1)
Calcium chloride ... short tons	(1)	(1)		
Cement ... barrels	13,225,868	19,148,864	11,877,642	17,900,739
Chromite ... long tons	269	2,978	2,033	14,008
Clay:				
Products (other than pottery and refractories)		[2] 6,787,516		[2] 8,020,197
Raw (sold by producers) ... short tons	334,513	763,559	382,224	918,974
Coal ... do			(1 3)	(1 4)
Copper ... pounds	8,762,000	806,104	10,502,000	1,270,742
Diatomite ... short tons	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	4,700	41,050	1,836	9,660
Ferro-alloys ... do	(1 5)	(1 5)		
Fuller's earth ... short tons	1,311	22,069	(1)	(1)
Gems and precious stones		(6)		(6)
Gold ... troy ounces	1,077,442	37,710,470	1,174,578	41,110,230
Gypsum ... short tons	[7] 142,853	(1 7)	[8] 186,158	[8] 355,834
Iodine ... pounds	233,925	212,635	299,286	242,422
Iron ore—				
Sold to furnaces ... long tons	31,045	(1)	97	808
Sold for paint ... do	(1)	(1)	(1)	(1)
Kyanite ... short tons	(9)	(9)	(9)	(9)
Lead ... do	482	44,344	1,186	139,948
Lime ... do	67,951	672,284	71,965	737,387
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)	8,693	694,744	9,743	878,624
Mica, scrap ... short tons			(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	320,406,000	82,401,000	329,769,000	91,089,000
Natural gasoline ... gallons	593,416,000	35,437,000	623,894,000	37,719,000
Ores (crude), etc.:				
Copper ... short tons	453,877	(10)	447,248	(10)
Dry and siliceous (gold and silver) ... do	4,179,341	(10)	4,472,637	(10)
Lead ... do	1,973	(10)	5,009	(10)
Zinc-lead ... do	500	(10)	120	(10)
Peat ... do	3,739	20,741	4,057	23,131
Petroleum ... barrels	214,773,000	215,900,000	238,521,000	242,100,000
Platinum and allied metals ... troy ounces	799	38,127	568	32,773
Potassium salts ... short tons	(1)	(1)	(1)	(1)
Pumice ... do	23,775	155,228	24,206	124,970
Pyrites ... long tons	(1)	(1)	(1)	(1)
Salt ... short tons	368,290	2,576,873	370,911	1,817,830
Sand and gravel ... do	12,627,423	6,138,579	12,575,937	6,749,768
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Silica (quartz) ... do	(1)	(1)	746	6,072
Silver ... troy ounces	2,103,799	1,629,392	2,888,265	2,234,073
Slate		47,289		39,694
Sodium salts (carbonates and sulfates) (natural) short tons	136,376	1,268,014	182,609	1,777,266
Stone ... do	12,826,370	10,163,893	8,356,260	7,007,329
Sulfur ... long tons	(1)	(1)	(1)	(1)
Sulfuric acid [11] ... short tons	(1 5)	(1 5)	(1 5)	(1 5)
Talc and ground soapstone ... do	28,199	403,392	32,495	427,031
Tripoli ... do	(1)	(1)	313	3,756
Tungsten ore (60-percent concentrates) ... do	(1)	(1)	577	(1)
Zinc ... do	8	800	20	2,600
Miscellaneous [12]		8,442,060		7,026,348
Total value, eliminating duplications		437,565,809		476,974,925

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
4 Value is estimated from various sources and includes selling expenses.
5 Value not included in total value for State.
6 No canvass.
7 Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
8 Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
9 Figures not available.
10 Not valued as ore; value of recoverable metal content included under the metals.
11 1936: From zinc-roasting operation; 1937: From roasting of high-sulfide gold and silver concentrates.
12 Includes minerals indicated by "1" above.

Mineral production of Colorado, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement .... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----------	[2] $1,208,257	----------	[2] $1,446,433
Raw (sold by producers) .... short tons	107,814	126,210	125,018	152,503
Coal .... do	[3] 6,811,802	[3] 16,277,000	[3] 7,187,211	[4] 18,327,000
Coke .... do	398,634	(1 5)	551,167	(1 5)
Copper .... pounds	17,730,000	1,631,160	21,868,000	2,646,028
Feldspar (crude) .... long tons	25,806	101,950	42,221	178,148
Ferro-alloys .... do	----------	----------	(1 5)	(1 5)
Fluorspar .... short tons	9,412	(1)	7,883	98,493
Fuller's earth .... do	(1)	(1)	(1)	(1)
Gems and precious stones	----------	(6)	----------	(6)
Gold .... troy ounces	366,607	12,831,245	368,905	12,911,675
Gypsum .... short tons	[7] 27,424	(1 7)	[8] 28,586	[8] 50,034
Iron, pig .... long tons	(1 5)	(1 5)	(1 5)	(1 5)
Lead .... short tons	7,267	668,564	9,786	1,154,748
Lime .... do	(1)	(1)	7,163	72,831
Manganiferous ore .... long tons	10,568	(1)	11,577	59,385
Mica:				
Scrap .... short tons	(1)	(1)	(1)	(1)
Sheet .... pounds	----------	----------	(1)	(1)
Mineral waters .... gallons sold	(6)	(6)	(6)	(6)
Molybdenum .... pounds	16,001,816	(1)	23,566,481	(1)
Natural gas .... M cubic feet	3,687,000	807,000	3,186,000	673,000
Natural gasoline .... gallons	451,000	18,000	404,000	16,000
Ores (crude), etc.:				
Copper .... short tons	253,871	(9)	261,658	(9)
Dry and siliceous (gold and silver) .... do	1,861,431	(9)	1,681,183	(9)
Lead .... do	25,724	(9)	30,235	(9)
Lead-copper .... do	910	(9)	537	(9)
Zinc .... do	----------	----------	135	(9)
Zinc-lead .... do	9,913	(9)	94,871	(9)
Peat .... do	(1)	(1)	(1)	(1)
Petroleum .... barrels	1,650,000	1,660,000	1,605,000	1,800,000
Pyrites .... long tons	8,722	(1)	5,890	(1)
Sand and gravel .... short tons	3,400,051	1,653,426	4,287,491	1,986,015
Silver .... troy ounces	5,902,776	4,571,700	6,260,693	4,842,646
Stone .... short tons	1,119,900	985,120	[10] 1,018,100	[10] 814,930
Sulfur ore .... long tons	13	(1)	11	(1)
Tantalum ore (columbo-tantalite) .... pounds	----------	----------	(1)	(1)
Tungsten ore (60-percent concentrates) .... short tons	180	154,431	219	(1)
Uranium and vanadium ores .... do	(1)	(1)	(1)	(1)
Vermiculite .... do	(1)	(1)	(1)	(1)
Zinc .... do	1,172	117,200	4,247	552,110
Miscellaneous [11]	----------	19,668,878	----------	28,139,619
Total value, eliminating duplications	----------	56,214,827	----------	67,338,548

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of marble and dimension limestone, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "1" and "10" above.

Mineral production of Connecticut, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Clay:				
Products (other than pottery and refractories)		[1] $825,566		[1] $992,528
Raw (sold by producers) short tons	(2)	(2)	3,156	3,944
Coke do	(2 3)	(2 3)	(2 3)	(2 3)
Feldspar (crude) long tons	(2)	(2)	(2)	(2)
Lime short tons	(2)	(2)	(2)	(2)
Mica:				
Scrap do	705	11,741	561	8,616
Sheet pounds	249,184	56,650	401,811	43,288
Mineral waters gallons sold	(4)	(4)	(4)	(4)
Sand and gravel short tons	1,213,726	516,013	1,293,617	573,643
Stone do	1,626,850	1,756,193	[5] 1,661,630	[5] 1,859,648
Miscellaneous [6]		3,221,898		3,438,300
Total value, eliminating duplications		3,317,494		3,689,554

[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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Clay:				
Products (other than pottery and refractories)		(1 2)		[2] $195,276
Raw (sold by producers) short tons	(1)	(1)	(1)	(1)
Sand and gravel do	83,667	$51,794	83,994	47,468
Stone do	(1)	(1)	(1)	(1)
Miscellaneous [3]		392,299		154,618
Total value, eliminating duplications		444,093		397,362

[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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Stone short tons			(1)	(1)
Miscellaneous		$547,576		$522,687
Total value, eliminating duplications		547,576		522,687

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.

Mineral production of Florida, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement...barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)......	....	(1 2)	....	2 $132,898
Raw (sold by producers)...short tons..	(1)	(1)	(1)	(1)
Diatomite...do....	275	$27,500	(1)	(1)
Fuller's earth...do....	(1)	(1)	(1)	(1)
Lime...do....	16,407	150,524	19,008	177,929
Mineral waters...gallons sold..	(3)	(3)	(3)	(3)
Peat...short tons..	(1)	(1)	(1)	(1)
Phosphate rock...long tons..	2,624,900	8,528,523	2,996,820	9,142,985
Sand and gravel...short tons..	629,662	394,908	965,322	751,523
Sand-lime brick...thousands..	(1 2)	(1 2)	(1 2)	(1 2)
Stone...short tons..	1,595,280	1,620,428	1,600,380	1,408,749
Miscellaneous [4]...	....	2,251,360	....	2,197,874
Total value, eliminating duplications...	....	12,973,243	....	13,811,958

[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 Georgia, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Barite...short tons..	38,435	$206,336	71,944	$400,687
Bauxite...long tons..	(1)	(1)	(1)	(1)
Cement...barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)......	....	2 1,848,533	....	2 2,118,952
Raw (sold by producers)...short tons..	448,022	2,920,192	506,232	3,548,559
Coal...do....	3 24,288	4 56,000	(1 3)	(1 4)
Fuller's earth...do....	(1)	(1)	(1)	(1)
Gems and precious stones...	....	(5)	....	(5)
Gold...troy ounces..	450	15,735	743	25,995
Iron ore...long tons..	5,740	11,408	14,593	19,130
Kyanite...short tons..	(6)	(6)	(6)	(6)
Lime...do....	8,271	45,478	7,964	62,196
Manganese ore...long tons..	3,821	49,333	689	11,423
Manganiferous ore...do....	3,144	12,020	9,537	28,459
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..	190	(7)	1,406	(7)
Sand and gravel...do....	319,849	140,156	429,122	211,026
Silver...troy ounces..	28	21	49	38
Slate...	....	(1)	....	(1)
Stone...short tons..	1,422,240	4,122,706	1,737,760	3,597,039
Talc...do....	11,473	114,545	11,984	148,177
Miscellaneous [8]...	....	2,214,129	....	2,412,379
Total value, eliminating duplications...	....	11,756,592	....	12,584,060

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Antimony ore (concentrates)....short tons..	3,787	(1)	3,295	(1)
Arsenious oxide....do....	(1)	(1)	(1)	(1)
Cement....barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)......	------------	[2] $104,908	------------	[2] $139,054
Raw (sold by producers)....short tons..	(1)	(1)	(1)	(1)
Coal....do....	(1 3)	(1 3)	(1 3)	(1 4)
Copper....pounds..	2,954,000	271,768	4,464,000	540,144
Diatomite....short tons..	------------	------------	50	500
Gems and precious stones....	------------	(5)	------------	(5)
Gold....troy ounces..	80,291	2,810,199	81,861	2,865,135
Gypsum....short tons..	(1 6)	(1 6)	(1 7)	(1 7)
Lead....do....	91,339	8,403,188	103,711	12,237,898
Lime....do....	------------	------------	(1)	(1)
Ores (crude), etc.:				
Copper....do....	284	(8)	850	(8)
Dry and siliceous (gold and silver)....do....	515,138	(8)	531,514	(8)
Lead....do....	305,967	(8)	412,378	(8)
Zinc-lead....do....	986,141	(8)	1,130,660	(8)
Phosphate rock....long tons..	47,113	203,264	83,436	356,037
Sand and gravel....short tons..	1,479,322	760,761	1,722,201	728,988
Silver....troy ounces..	14,537,530	11,259,317	19,587,766	15,151,137
Stone....short tons..	[9] 948,150	[9] 688,860	891,270	700,627
Tungsten ore (60-percent concentrates)....do....	11	(1)	99	(1)
Zinc....do....	49,100	4,910,000	54,199	7,045,870
Miscellaneous [10]....	------------	553,699	------------	867,729
Total value, eliminating duplications....	------------	29,965,964	------------	40,633,119

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
4 Value is estimated from various sources and includes selling expenses.
5 No canvass.
6 Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
7 Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 Exclusive of unclassified stone, value for which is included under "Miscellaneous."
10 Includes minerals indicated by "1" and "9" above.

Mineral production of Illinois, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement barrels	[1] 4,949,318	[1] $7,056,344	[1] 4,713,734	[1] $6,756,747
Clay:				
Products (other than pottery and refractories)		[2] 6,185,049		[2] 6,545,686
Raw (sold by producers) short tons	126,396	278,996	161,537	339,706
Coal do	[3] 50,926,599	[3] 81,444,000	[3] 51,601,638	[4] 89,271,000
Coke do	2,082,516	[5] 13,098,787	2,998,663	[5] 20,213,129
Fluorspar do	82,056	1,525,606	78,664	1,730,585
Fuller's earth do	(6)	(6)	(6)	(6)
Iron, pig long tons	2,991,740	[5] 54,583,804	3,357,959	[5] 70,893,278
Lead short tons	294	27,048	186	21,948
Lime do	144,675	1,057,765	142,122	1,039,087
Mineral paints (zinc and lead pigments) do	18,162	[5] 1,640,843	22,171	[5] 2,406,423
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	865,000	433,000	1,040,000	533,000
Natural gasoline gallons	2,337,000	134,000	2,567,000	153,000
Ore (lead and zinc) short tons	(8)	(8)	(8)	(8)
Petroleum barrels	4,475,000	5,390,000	7,499,000	9,970,000
Pyrites long tons	9,472	15,660	10,220	(6)
Sand and gravel short tons	12,418,495	6,017,468	14,333,482	7,486,610
Sand and sandstone (finely ground) do	82,877	483,952	96,329	575,251
Sand-lime brick thousands	(2 6)	(2 6)		
Silver troy ounces	1,780	1,379	887	686
Stone short tons	9,359,170	7,295,011	[9] 9,887,260	[9] 8,383,931
Sulfuric acid (60° Baumé)[10] do	140,857	[5] 1,252,219	142,206	[5] 1,326,782
Tripoli do	10,981	138,063	11,647	151,154
Miscellaneous[11]		432,787		479,163
Total value, eliminating duplications		117,916,128		133,437,554

[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 National Bituminous Coal Commission.
[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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $4,480,778		[2] $4,670,619
Raw (sold by producers) short tons	49,552	73,759	41,369	65,017
Coal do	[3] 17,822,536	[3] 26,932,000	[3] 17,764,774	[4] 28,601,000
Coke do	5,449,755	[5] 40,627,036	5,467,061	[5] 32,655,355
Fuller's earth do	(1)	(1)		
Iron, pig long tons	3,256,677	[5] 59,067,654	3,694,360	[5] 77,990,597
Lime short tons	93,370	559,048	94,053	552,243
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	2,241,000	1,355,000	1,551,000	996,000
Peat short tons	(1)	(1)		
Petroleum barrels	822,000	1,010,000	844,000	1,140,000
Rubbing stones and whetstones short tons	95	14,401	115	18,288
Sand and gravel do	6,938,235	3,340,781	6,598,723	3,227,514
Sand-lime brick thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone short tons	3,510,530	5,876,759	[7] 3,504,530	[7] 6,397,891
Miscellaneous[8]		10,472,468		10,769,362
Total value, eliminating duplications		52,281,539		54,886,756

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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 sandstone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "1" and "7" above.

Mineral production of Iowa, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement....barrels..	4,407,624	$6,908,225	4,598,453	$7,046,021
Clay:				
Products (other than pottery and refractories)......	....	[1] 2,728,810	....	[1] 3,250,677
Raw (sold by producers)....short tons..	4,411	46,023	4,600	50,871
Coal....do....	[2] 3,960,700	[3] 9,940,000	[2] 3,637,054	[3] 9,529,000
Ferro-alloys....long tons..	(4 5)	(4 5)	(4 5)	(4 5)
Gypsum....short tons..	[6] 344,221	[6] 3,261,388	[7] 387,255	[7] 533,162
Iron, pig....long tons..	(4 5)	(4 5)	(4 5)	(4 5)
Mineral waters....gallons sold..	(8)	(8)	(8)	(8)
Peat....short tons..	(4)	(4)	(4)	(4)
Sand and gravel....do....	6,293,984	2,048,282	6,397,154	2,235,103
Stone....do....	[9] 4,003,550	[9] 3,397,356	4,294,310	4,276,891
Miscellaneous [10]....	....	1,762,575	....	2,163,370
Total value, eliminating duplications....	....	28,359,140	....	26,941,350

[1] Figures obtained through cooperation with Bureau of the Census.
[2] According to National Bituminous Coal Commission.
[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] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] No canvass.
[9] Exclusive of sandstone, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "4" and "9" above.

Mineral production of Kansas, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Asphalt (native)....short tons..	(1)	(1)	(1)	(1)
Cement....barrels..	[2] 3,568,090	[2] $5,550,200	[2] 3,500,684	[2] $5,482,851
Chats....short tons..	(3)	(3)	(3)	(3)
Clay products (other than pottery and refractories)..	....	[4] 1,061,448	....	[4] 1,408,376
Coal....short tons..	[5] 2,944,028	[6] 5,394,000	[5] 2,892,560	[6] 5,612,000
Gypsum....do....	(1 7)	(1 7)	(1 8)	(1 8)
Lead....do....	11,409	1,049,628	16,008	1,888,944
Mineral paints (zinc and lead pigments)....do....	(1 9)	(1 9)	(1 9)	(1 9)
Mineral waters....gallons sold..	(10)	(10)	(10)	(10)
Natural gas....M cubic feet..	69,178,000	23,126,000	83,890,000	30,376,000
Natural gasoline....gallons..	37,775,000	1,542,000	57,026,000	2,192,000
Ores (crude), etc.:				
Zinc....short tons..	2,821,900	(11)	3,526,600	(11)
Zinc-lead....do....	1,822,900	(11)	2,081,300	(11)
Petroleum....barrels..	58,317,000	65,900,000	70,761,000	88,100,000
Pumice....short tons..	42,057	117,757	38,438	111,655
Pyrites....long tons..	6,902	(1)	15,843	(1)
Salt....short tons..	704,164	2,580,166	654,089	2,759,062
Sand and gravel....do....	2,454,017	920,730	2,495,196	1,017,515
Stone....do....	4,934,510	5,747,261	[12] 3,540,860	[12] 4,763,080
Zinc....do....	79,017	7,901,700	80,300	10,439,000
Miscellaneous [13]....	....	3,074,770	....	2,788,921
Total value, eliminating duplications....	....	121,689,562	....	154,376,403

[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 National Bituminous Coal Commission.
[6] Value is estimated from various sources and includes selling expenses.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Value not included in total value for State.
[10] No canvass.
[11] Not valued as ore; value of recoverable metal content included under the metals.
[12] Exclusive of unclassified stone, value for which is included under "Miscellaneous."
[13] Includes minerals indicated by "1", "2", and "12" above.

Mineral production of Kentucky, 1936–37

Product	1936		1937	
	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] $1,224,578		[2] $1,220,962
Raw (sold by producers) short tons	237,351	858,255	340,325	1,193,410
Coal do	[3] 47,521,950	[3] 77,678,000	[3] 47,086,444	[4] 86,639,000
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Fluorspar do	80,241	1,409,433	87,296	1,710,122
Fluorspar, optical pounds			50	120
Iron, pig long tons	225,214	(1 5)	243,010	(1 5)
Lead short tons	50	4,600	89	10,502
Lime do	(1)	(1)	(1)	(1)
Marl, calcareous do			(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	43,903,000	19,200,000	55,719,000	22,904,000
Natural gasoline gallons	6,009,000	346,000	7,344,000	382,000
Ores (lead and zinc) short tons	(7)	(7)	(7)	(7)
Petroleum barrels	5,633,000	7,240,000	5,484,000	7,680,000
Sand and gravel short tons	1,272,267	915,664	1,100,682	804,210
Stone do	2,836,860	2,396,842	[8] 3,433,190	[8] 3,040,322
Zinc do	238	23,800	270	35,100
Miscellaneous [9]		8,620,875		8,134,709
Total value, eliminating duplications		113,435,307		127,423,680

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Louisiana, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement barrels	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)		[2] $237,671		[2] $489,255
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Natural gas M cubic feet	290,151,000	53,641,000	315,301,000	53,908,000
Natural gasoline gallons	72,687,000	2,945,000	106,415,000	4,300,000
Petroleum barrels	80,491,000	85,600,000	90,924,000	110,300,000
Salt short tons	918,414	2,436,971	974,403	2,898,826
Sand and gravel do	2,078,546	1,467,690	2,065,447	1,250,439
Stone do	(1)	(1)	(1)	(1)
Sulfur long tons	333,475	5,980,101	429,602	7,705,448
Miscellaneous [4]		1,049,964		1,266,937
Total value, eliminating duplications		153,358,397		182,118,905

[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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		2 $343,217		2 $358,589
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Feldspar (crude) ... long tons	16,392	91,265	20,191	110,928
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	3,685,991	335,387	2,742,489	706,856
Silica (quartz) ... do			67	168
Slate		285,701		388,521
Stone ... short tons	4 203,970	4 1,401,234	4 265,340	4 1,546,037
Miscellaneous 5		966,549		1,018,292
Total value, eliminating duplications		3,423,353		4,129,391

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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asbestos ... short tons	(1)	(1)	(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		2 $1,320,662		2 $1,313,811
Raw (sold by producers) ... short tons	30,416	119,924	33,311	125,947
Coal ... do	3 1,703,589	3 3,351,000	3 1,548,980	4 3,315,000
Coke ... do	1,217,039	(1 5)	1,513,651	(1 5)
Feldspar (crude) ... long tons	(1)	(1)	(1)	(1)
Gold ... troy ounces	668	23,380	1,040	36,400
Iron, pig ... long tons	1,219,852	(1 5)	1,514,372	(1 5)
Lime ... short tons	50,410	324,209	59,575	404,562
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Ore (dry and siliceous) (gold and silver) ... short tons	1,370	(7)	2,000	(7)
Potassium salts ... do	(1)	(1)	(1)	(1)
Sand and gravel ... do	2,200,176	2,056,614	2,441,612	2,236,132
Silica (quartz) ... do	525	7,155	410	5,850
Silver ... troy ounces	33	26	40	31
Slate		(1)		(1)
Stone ... short tons	8 1,423,110	8 1,735,306	8 836,800	8 1,139,767
Talc ... do	(1)	(1)	(1)	(1)
Miscellaneous 9		31,669,981		41,790,766
Total value, eliminating duplications		11,157,550		10,634,854

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
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, value for which is included under "Miscellaneous."
9 Includes minerals indicated by "1" and "8" above.

Mineral production of Massachusetts, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $807,568		[1] $804,895
Raw (sold by producers) short tons	1,344	12,570	2,125	17,868
Coke do	1,108,219	[2] 6,766,722	1,130,620	([2] [3])
Diatomite do			([3])	([3])
Fuller's earth do	([3])	([3])		
Iron, pig long tons	([2] [3])	([2] [3])	([2] [3])	([2] [3])
Lime short tons	92,625	839,948	101,247	897,356
Mineral waters gallons sold	([4])	([4])	([4])	([4])
Peat short tons	([3])	([3])	([3])	([3])
Sand and gravel do	2,734,346	1,133,006	2,884,784	1,421,390
Sand and sandstone (finely ground) do	543	3,324	2,613	12,448
Sand-lime brick thousands	([1] [3])	([1] [3])	[1] 18,741	[1] 168,672
Stone short tons	[5] 2,420,420	[5] 4,608,010	[5] 2,353,500	[5] 4,408,297
Miscellaneous [6]		767,327		9,083,198
Total value, eliminating duplications		7,559,253		7,813,345

[1] Figures obtained through cooperation with Bureau of the Census.
[2] Value not included in total value for State.
[3] Value included under "Miscellaneous."
[4] No canvass.
[5] Exclusive of sandstone in 1936 and of marble in 1937, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "[3]" and "[5]" above.

Mineral production of Michigan, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Bromine ... pounds	12,421,677	$2,498,545	13,494,677	$2,697,666
Calcium chloride ... short tons	(1)	(1)	84,527	1,213,985
Cement ... barrels	7,960,821	10,482,835	7,831,880	9,836,999
Clay:				
Products (other than pottery and refractories)		[2] 1,513,643		[2] 1,838,709
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	[3] 626,145	[3] 2,118,000	[3] 562,262	[4] 2,047,000
Coke ... do	2,293,653	[5] 13,738,700	2,283,518	[5] 13,816,401
Copper ... pounds	95,968,019	8,829,058	94,928,000	11,486,288
Gems and precious stones		(6)		(6)
Gold ... troy ounces			51	1,800
Graphite, amorphous ... short tons			(1)	(1)
Gypsum ... do	[7] 496,611	[7] 4,748,950	[8] 553,242	[8] 896,947
Iron:				
Ore—				
Sold to furnaces ... long tons	10,491,270	30,721,075	12,626,935	41,136,202
Sold for paint ... do	897	(1)	1,118	(1)
Pig ... do	873,341	[5] 13,585,519	886,602	[5] 15,064,083
Lime ... short tons	40,090	286,348	48,310	351,681
Magnesium ... pounds	3,903,312	(1)	4,539,980	(1)
Magnesium salts (natural):				
Carbonate ... do	(1)	(1)	(1)	(1)
Chloride ... do	(1)	(1)	(1)	(1)
Sulfate ... do	(1)	(1)	(1)	(1)
Manganiferous ore ... long tons	9,627	29,775	9,739	32,442
Marl, calcareous ... short tons	(1)	(1)	1,270	553
Mineral waters ... gallons sold	(6)	(6)	(6)	(6)
Natural gas ... M cubic feet	7,167,000	3,549,000	9,080,000	5,640,000
Natural gasoline ... gallons	2,015,000	106,000	2,408,000	103,000
Ores (crude), etc.:				
Copper ... short tons	3,225,600	(9)	4,197,881	(9)
Dry and siliceous (gold and silver) ... do			600	(9)
Peat ... do	5,489	40,295	5,276	28,832
Petroleum ... barrels	11,928,000	15,950,000	16,628,000	21,950,000
Salt ... short tons	2,354,282	5,882,718	2,476,406	6,506,120
Sand and gravel ... do	10,862,851	4,310,931	10,987,148	4,430,584
Sand-lime brick ... thousands	[2] 25,191	[2] 226,651	[2] 16,107	[2] 144,597
Silver ... troy ounces			25,454	19,689
Stone ... short tons	10,690,410	5,391,789	[10] 12,347,790	[10] 6,553,610
Miscellaneous [11]		3,960,879		2,250,869
Total value, eliminating duplications		100,646,492		119,167,573

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of sandstone, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "[1]" and "[10]" above.

Mineral production of Minnesota, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement .... barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)..	....	[2] $1,048,507	....	[2] $962,572
Raw (sold by producers) .... short tons..	3,579	7,663	3,116	6,250
Coke .... do....	521,518	[3] 4,120,984	704,631	[3] 5,611,287
Flint lining for tube mills .... do....	(1)	(1)	(1)	(1)
Gems and precious stones	....	(4)	....	(4)
Iron:				
Ore—				
Sold to furnaces .... long tons..	32,938,883	83,523,720	47,878,042	141,542,594
Sold for paint .... do....	1,903	(1)	....	....
Pig .... do....	101,475	(1 3)	248,363	(1 3)
Lime .... short tons..	(1)	(1)	(1)	(1)
Manganiferous ore .... long tons..	888,521	(1)	1,257,900	3,451,795
Marl, calcareous .... short tons..	(1)	(1)	340	290
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....	7,342,987	2,692,223	7,781,830	1,905,441
Sand-lime brick .... thousands..	(1 2)	(1 2)	[2] 16,880	[2] 127,829
Stone .... short tons..	982,690	2,526,869	[5] 822,680	[5] 1,991,199
Miscellaneous [6]	....	6,754,802	....	7,503,912
Total value, eliminating duplications	....	94,568,991	....	152,107,070

[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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	....	[1] $588,025	....	[1] $623,023
Raw (sold by producers) .... short tons..	(2)	(2)	(2)	(2)
Fuller's earth .... do....	....	....	(2)	(2)
Iron ore .... long tons..	....	....	97	(2)
Mineral waters .... gallons sold..	(3)	(3)	(3)	(3)
Natural gas .... M cubic feet..	11,821,000	2,646,000	13,348,000	3,041,000
Sand and gravel .... short tons..	1,136,841	549,794	2,814,696	1,008,722
Stone .... do....	(2)	(2)	(2)	(2)
Miscellaneous [4]	....	62,285	....	149,205
Total value, eliminating duplications	....	3,846,104	....	4,821,950

[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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Barite do	160,866	$1,008,528	198,101	$1,430,397
Cement barrels	4,632,191	7,134,240	4,565,448	7,041,016
Chats short tons	2,784,800	485,000	1,984,340	213,436
Clay:				
Products (other than pottery and refractories)		[2] 2,425,985		[2] 2,542,404
Raw (sold by producers) short tons	472,246	1,336,382	519,561	1,529,239
Coal do	[3] 3,984,999	[3] 7,559,000	[3] 4,091,394	[4] 7,978,000
Coke do	(1 5)	(1 5)	(1 5)	(1 5)
Copper pounds	382,000	35,144	538,000	65,098
Iron ore—				
Sold to furnaces long tons	2,933	16,566	19,897	57,687
Sold for paint do	837	(1)	1,500	(1)
Lead short tons	110,428	10,159,376	157,631	18,600,458
Lime do	379,354	2,047,189	426,514	2,326,928
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	399,000	196,000	444,000	226,000
Ores (crude), etc.:				
Lead short tons	3,420,600	(7)	5,012,631	(7)
Zinc do	408,700	(7)	438,100	(7)
Zinc-lead do	460,700	(7)	542,000	(7)
Petroleum barrels	40,000	35,000	40,000	42,000
Pyrites long tons	27,293	77,660	(1)	(1)
Sand and gravel short tons	4,074,565	2,402,304	4,409,708	2,481,464
Sand and sandstone (finely ground) do	(1)	(1)	(1)	(1)
Sand-lime brick thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver troy ounces	163,720	126,801	179,700	138,999
Stone short tons	[8] 3,443,930	[8] 4,142,950	[8] 3,635,250	[8] 4,742,459
Tripoli do	(1)	(1)	(1)	(1)
Tungsten ore (60-percent concentrates) do			(1)	(1)
Zinc do	18,709	1,870,900	20,600	2,678,000
Miscellaneous [9]		1,729,945		2,243,344
Total value, eliminating duplications		41,350,860		52,446,272

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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 unclassified stone in 1936 and of sandstone in 1937, value for which is included under "Miscellaneous."
[9] Includes minerals indicated by "1" and "8" above.

Mineral production of Montana, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Arsenious oxide — short tons	(1)	(1)	(1)	(1)
Asbestos — do	(1)	(1)	(1)	(1)
Cement — barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $235,151		[2] $151,529
Raw (sold by producers) — short tons	(1)	(1)	8,645	7,111
Coal — do	[3] 2,988,524	[3] 4,437,000	[3] 2,965,193	[4] 4,423,000
Copper — pounds	219,088,000	20,156,096	289,056,000	34,975,776
Gems and precious stones		(5)		(5)
Gold — troy ounces	180,209	6,307,322	202,252	7,078,820
Graphite, crystalline — pounds	(1)	(1)	(1)	(1)
Gypsum — short tons	(1 6)	(1 6)	(1 7)	(1 7)
Lead — do	19,059	1,753,428	17,957	2,118,926
Lime — do	10,962	75,867	13,295	79,201
Manganese ore — long tons	16,456	487,419	26,744	785,129
Manganiferous ore — do	20,307	86,037	19,660	114,692
Mineral waters — gallons sold	(5)	(5)	(5)	(5)
Natural gas — M cubic feet	23,003,000	6,217,000	24,765,000	6,667,000
Natural gasoline — gallons	2,071,000	100,000	2,296,000	161,000
Ores (crude), etc.:				
Copper — short tons	2,429,529	(8)	3,426,395	(8)
Dry and siliceous (gold and silver) — do	798,554	(8)	904,489	(8)
Lead — do	4,036	(8)	13,867	(8)
Zinc — do	93,902	(8)	125,395	(8)
Zinc-lead — do	527,095	(8)	427,863	(8)
Petroleum — barrels	5,868,000	7,700,000	5,805,000	7,300,000
Phosphate rock — long tons	36,022	76,066	50,834	133,138
Pyrites — do	(1)	(1)	(1)	(1)
Sand and gravel — short tons	5,318,312	1,699,775	4,601,999	1,590,403
Silver — troy ounces	11,600,563	8,984,636	11,812,093	9,136,654
Stone — short tons	357,140	276,938	[9] 340,450	[9] 439,785
Tungsten ore (60-percent concentrates) — do	(1)	(1)	14	(1)
Vermiculite — do	(1)	(1)	(1)	(1)
Zinc — do	49,717	4,971,700	39,168	5,091,840
Miscellaneous [10]		2,004,715		1,832,811
Total value, eliminating duplications		65,569,150		82,086,815

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined: value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years 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 Nebraska, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement — barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		(1 2)		[2] $473,227
Raw (sold by producers) — short tons	8,278	$10,535	6,904	8,371
Mineral waters — gallons sold	(3)	(3)	(3)	(3)
Pumice — short tons	(1)	(1)	5,777	38,130
Sand and gravel — do	1,971,986	751,178	2,850,963	1,061,589
Stone — do	259,390	388,800	763,710	1,146,335
Miscellaneous		2,693,049		2,110,157
Total value, eliminating duplications		3,843,562		4,837,809

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

Mineral production of Nevada, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Antimony ore......short tons..	80	(1)	38	$300
Barite......do....	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)......	....	....	....	(1 2)
Raw (sold by producers)......short tons..	....	....	(1)	(1)
Copper......pounds..	141,392,000	$13,008,064	149,206,000	18,053,926
Diatomite......short tons..	249	6,866	275	8,180
Fluorspar......do....	2,126	(1)	2,544	(1)
Fuller's earth......do....	(1)	(1)	4,485	51,718
Gems and precious stones......	....	(3)	....	(3)
Gold......troy ounces..	286,370	10,022,950	281,332	9,846,620
Graphite, amorphous......short tons..	(1)	(1)	(1)	(1)
Gypsum......do....	[4] 167,342	(1 4)	[5] 160,347	[5] 268,638
Iron ore......long tons..	340	(1)	196	(1)
Lead......short tons..	10,712	985,504	9,347	1,102,946
Lime......do....	(1)	(1)	(1)	(1)
Magnesium oxide (hydrated) (brucite)......do....	(1)	(1)	(1)	(1)
Manganiferous ore......long tons..	....	....	533	3,167
Marl, calcareous......short tons..	(1)	(1)	(1)	(1)
Mercury......flasks (76 pounds)..	211	16,863	198	17,855
Mineral waters......gallons sold..	(3)	(3)	(3)	(3)
Molybdenum......pounds..	(1)	(1)	....	....
Ores (crude), etc.:				
Copper......short tons..	4,668,590	(6)	5,669,388	(6)
Dry and siliceous (gold and silver)......do....	1,725,498	(6)	1,729,048	(6)
Lead......do....	25,247	(6)	11,218	(6)
Lead-copper......do....	75	(6)	1,003	(6)
Zinc......do....	....	....	103,305	(6)
Zinc-lead......do....	164,728	(6)	51,504	(6)
Sand and gravel......do....	1,863,678	693,105	1,710,819	785,947
Silver......troy ounces..	5,068,786	3,925,775	4,864,750	3,762,884
Sodium sulfate (natural)......short tons..	(1)	(1)	....	....
Stone......do....	521,760	304,668	[7] 76,340	[7] 66,217
Sulfur ore......long tons..	....	....	210	(1)
Tungsten ore (60-percent concentrates)......short tons..	1,631	(1)	2,153	(1)
Vanadium ores......do....	147	(1)	....	....
Zinc......do....	13,477	1,347,700	14,236	1,850,680
Miscellaneous [8]......	....	2,381,634	....	3,052,738
Total value, eliminating duplications......	....	32,693,129	....	38,871,816

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[5] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of limestone, value for which is included under "Miscellaneous."
[8] Includes minerals indicated by "[1]" and "[7]" above.

Mineral production of New Hampshire, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Clay products (other than pottery and refractories)		[1] $324,155		[1] $300,219
Diatomite ... short tons			(2)	(2)
Feldspar (crude) ... long tons	26,494	157,729	28,831	155,925
Fluorspar ... short tons	257	(2)	478	(2)
Garnet, abrasive ... do	(2)	(2)	(2)	(2)
Gems and precious stones		(3)		(3)
Mica:				
Scrap ... short tons	250	3,610	306	4,397
Sheet ... pounds	285,822	22,920	235,055	20,119
Mineral waters ... gallons sold	(3)	(3)	(3)	(3)
Peat ... short tons	(2)	(2)	(2)	(2)
Sand and gravel ... do	2,509,255	264,117	2,207,922	252,784
Scythestones ... do	(2)	(2)	(2)	(2)
Silica (quartz) ... do			29	75
Stone ... do	81,660	374,401	71,090	442,772
Miscellaneous [4]		35,123		43,578
Total value, eliminating duplications		1,182,055		1,219,869

[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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $4,794,622		[2] $6,395,790
Raw (sold by producers) ... short tons	99,250	532,117	97,978	514,840
Coke ... do	1,007,500	(1 3)	1,015,073	(1 3)
Diatomite ... do	(1)	(1)	(1)	(1)
Ferro-alloys ... long tons	(1 3)	(1 3)	(1 3)	(1 3)
Fuller's earth ... short tons	(1)	(1)		
Iron ore ... long tons	194,295	(1)	544,635	2,474,087
Lime ... short tons	14,658	99,891	20,029	151,350
Manganiferous residuum ... long tons	124,288	(1)	115,998	(1)
Marl, greensand ... short tons	8,368	177,835	9,734	210,974
Mineral paints (zinc and lead pigments) ... do	(1 3)	(1 3)		
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ore (zinc) ... short tons	526,233	(5)	590,900	(5)
Peat ... do	(1)	(1)	13,175	72,768
Sand and gravel ... do	3,742,908	2,904,609	4,187,492	3,347,390
Sand and sandstone (finely ground) ... do	77,584	363,323	82,398	430,743
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silica (quartz) ... short tons	(1)	(1)		
Stone ... do	2,089,960	2,608,859	[6] 2,379,590	[6] 2,621,038
Zinc [7] ... do	89,883	9,868,010	101,408	13,461,309
Miscellaneous [8]		9,745,174		8,393,235
Total value, eliminating duplications		24,421,046		31,467,931

[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, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $147, 383		(1 2)
Raw (sold by producers) short tons	25, 468	88, 102	23, 571	$114, 914
Coal do	[3] 1, 596, 775	[3] 4, 325, 000	[3] 1, 714, 955	[4] 4, 973, 000
Copper pounds	6, 332, 000	582, 544	64, 106, 000	7, 756, 826
Fluorspar short tons	2, 045	(1)	3, 324	(1)
Gems and precious stones		(5)		(5)
Gold troy ounces	33, 037	1, 156, 295	41, 171	1, 440, 985
Iron ore long tons	17, 550	(1)	10, 497	(1)
Lead short tons	6, 626	609, 592	6, 512	768, 416
Lime do	(1)	(1)	902	8, 900
Manganese ore long tons			878	(1)
Manganiferous ore do	170	(1)	18, 581	(1)
Mica:				
Scrap short tons	(1)	(1)	(1)	(1)
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	33, 928, 000	5, 489, 000	46, 337, 000	7, 699, 000
Natural gasoline gallons	28, 921, 000	999, 000	38, 253, 000	1, 493, 000
Ores (crude), etc.:				
Copper short tons	31, 056	(6)	3, 631, 454	(6)
Dry and siliceous (gold and silver) do	122, 096	(6)	134, 253	(6)
Lead do	450	(6)	1, 853	(6)
Lead-copper do	950	(6)	396	(6)
Zinc do	} 287, 460	(6)	170, 510	(6)
Zinc-lead do			252, 626	(6)
Zinc-lead-copper do	72, 954	(6)		
Petroleum barrels	27, 223, 000	22, 930, 000	38, 854, 000	36, 600, 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	2, 062, 411	1, 575, 797	1, 686, 727	974, 763
Silver troy ounces	1, 163, 255	900, 941	1, 243, 766	962, 053
Stone short tons	1, 078, 570	862, 059	713, 500	302, 723
Tantalum ore (columbo-tantalite) pounds			(1)	(1)
Tin (metallic equivalent) do			(1)	(1)
Tungsten ore (60-percent concentrates) short tons	(1)	(1)	(1)	(1)
Zinc do	20, 668	2, 066, 800	23, 927	3, 110, 510
Miscellaneous [7]		4, 209, 493		6, 650, 655
Total value, eliminating duplications		45, 942, 006		72, 855, 745

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
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 New York, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Aluminum......pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Cement......barrels..	[3] 5,651,412	[3] $8,794,448	[3] 6,106,083	[3] $8,825,785
Clay:				
Products (other than pottery and refractories)..	....	[4] 4,280,059	....	[4] 5,435,096
Raw (sold by producers)......short tons..	3,940	25,393	6,465	41,020
Coke......do....	4,835,921	[2] 28,566,271	4,946,964	[2] 29,853,516
Diatomite......do....	(1)	(1)	(1)	(1)
Emery......do....	325	2,900	320	2,780
Feldspar (crude)......long tons..	(1)	(1)	(1)	(1)
Ferro-alloys......do....	187,016	[2] 16,346,231	166,137	[2] 18,079,832
Garnet, abrasive......short tons..	(1)	(1)	(1)	(1)
Graphite, artificial......pounds..	(1 2)	(1 2)	(1 2)	(1 2)
Gypsum......short tons..	[5] 609,204	[5] 6,585,277	[6] 700,357	[6] 1,107,175
Iron:				
Ore—				
Sold to furnaces......long tons..	801,236	(1)	(1)	(1)
Sold for paint......do....	(1)	(1)	(1)	(1)
Pig......do....	2,216,751	[2] 35,181,959	2,702,072	[2] 55,789,609
Lead......short tons..	(1)	(1)	(1)	(1)
Lime......do....	68,068	527,009	55,947	438,151
Millstones......	....	5,458	....	(1)
Mineral waters......gallons sold..	(7)	(7)	(7)	(7)
Natural gas......M cubic feet..	12,431,000	8,645,000	21,325,000	12,388,000
Natural gasoline......gallons..	22,000	2,000	33,000	2,000
Ores (crude), etc.:				
Zinc......short tons..	92,749	(8)	112,478	(8)
Zinc-lead......do....	284,702	(8)	352,392	(8)
Peat......do....	11,906	25,888	10,928	23,788
Petroleum......barrels..	4,663,000	11,380,000	5,478,000	14,140,000
Pyrites......long tons..	62,530	(1)	74,834	(1)
Salt......short tons..	2,021,983	5,609,932	2,084,867	5,795,551
Sand and gravel......do....	11,829,226	6,625,507	12,501,388	6,487,234
Sand-lime brick......thousands..	(1 4)	(1 4)	(1 4)	(1 4)
Silica (quartz)......short tons..	(1)	(1)	(1)	(1)
Silver......troy ounces..	18,251	14,135	41,500	32,100
Slate......	....	347,530	....	360,064
Stone......short tons..	9,411,430	10,033,309	10,882,980	11,244,495
Talc......do....	85,429	1,043,232	96,140	1,215,834
Zinc......do....	26,941	2,694,100	32,690	4,249,700
Miscellaneous [9]......	....	26,715,538	....	33,773,381
Total value, eliminating duplications......	....	71,647,775	....	77,665,874

[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] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[6] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Includes minerals indicated by "1" and "3" above.

Mineral production of North Carolina, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Aluminum .... pounds	(1 2)	(1 2)	(1 2)	(1 2)
Asbestos .... short tons	(1)	(1)	(1)	(1)
Bromine .... pounds	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	----------	[3] $3,080,434	----------	[3] $3,263,898
Raw (sold by producers) .... short tons	8,832	126,703	9,832	144,639
Copper .... pounds	(1)	(1)	(1)	(1)
Feldspar (crude) .... long tons	102,393	591,053	94,595	538,567
Garnet, abrasive .... short tons	(1)	(1)	(1)	(1)
Gems and precious stones	----------	(4)	----------	(4)
Gold .... troy ounces	2,037	71,301	949	33,203
Iron ore .... long tons	57	225	----------	----------
Kyanite .... short tons	(5)	(5)	(5)	(5)
Lead .... do	(1)	(1)	----------	----------
Lime .... do	(1)	(1)	(1)	(1)
Marl, calcareous .... do	----------	----------	(1)	(1)
Mica:				
Scrap .... do	10,840	131,138	12,988	209,212
Sheet .... pounds	730,446	119,653	1,044,328	218,176
Mineral waters .... gallons sold	(4)	(4)	(4)	(4)
Olivine .... short tons	(5)	(5)	(5)	(5)
Ores (crude):				
Copper .... do	19,148	(6)	22,015	(6)
Dry and siliceous (gold and silver) .... do	12,457	(6)	5,209	(6)
Sand and gravel .... do	1,515,829	528,499	1,824,082	539,501
Sand and sandstone (finely ground) .... do	----•----	----------	(1)	(1)
Silica (quartz) .... do	1,005	11,398	792	6,261
Silver .... troy ounces	5,575	4,318	5,538	4,284
Stone .... short tons	2,724,140	3,397,707	2,624,770	3,314,634
Talc and pyrophyllite .... do	27,877	280,026	28,250	271,013
Tantalum ore (columbo-tantalite) .... pounds	----------	----------	(1)	(1)
Vermiculite .... short tons	(1)	(1)	----------	----------
Miscellaneous [7]	----------	9,515,064	----------	13,049,056
Total value, eliminating duplications	----------	9,955,519	----------	11,160,444

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 Includes minerals indicated by "1" above.

Mineral production of North Dakota, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)	----------	(1 2)	----------	(1 2)
Raw (sold by producers) .... short tons	(1)	(1)	(1)	(1)
Coal .... do	2,215,335	$2,534,000	2,250,837	$2,639,000
Mineral waters .... gallons sold	(3)	(3)	(3)	(3)
Sand and gravel .... short tons	1,848,463	215,630	1,864,038	127,799
Stone .... do	----------	----------	44,570	15,012
Miscellaneous [4]	----------	152,823	----------	91,200
Total value, eliminating duplications	----------	2,902,453	----------	2,873,011

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 Ohio, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Asphalt (native) short tons	(1)	(1)		
Bromine pounds	(1)	(1)	------------	------------
Calcium chloride short tons	(1)	(1)	(1)	(1)
Cement barrels	[2] 5,546,500	[2] $7,741,485	[2] 5,501,769	[2] $7,771,268
Clay:				
Products (other than pottery and refractories)	------------	[3] 20,100,873	------------	[3] 23,327,740
Raw (sold by producers) short tons	409,361	865,976	452,258	1,001,343
Coal do	[4] 24,110,078	[4] 38,838,000	[4] 25,177,867	[5] 44,313,000
Coke do	6,242,300	[6] 26,938,007	6,737,881	[6] 32,185,945
Ferro-alloys long tons	106,095	[6] 4,451,512	156,653	[6] 6,229,723
Grindstones short tons	10,448	327,637	11,046	340,348
Gypsum do	(1 7)	(1 7)	(1 8)	(1 8)
Iron, pig long tons	7,351,407	[6] 125,087,158	7,724,882	[6] 167,076,855
Lime short tons	905,358	7,354,902	1,069,374	8,653,571
Marl, calcareous do	(1)	(1)	510	525
Mineral paints (zinc and lead pigments) do	(1 6)	(1 6)	(1 6)	(1 6)
Mineral waters gallons sold	(9)	(9)	(9)	(9)
Natural gas M cubic feet	46,994,000	22,153,000	42,783,000	19,967,000
Natural gasoline gallons	6,991,000	436,000	7,704,000	460,000
Peat short tons	4,793	28,684	3,160	26,900
Petroleum barrels	3,847,000	6,090,000	3,559,000	5,820,000
Rubbing stones, scythestones, and whetstones short tons	170	21,736	320	33,706
Salt do	1,633,056	2,545,027	1,733,875	2,625,644
Sand and gravel do	8,250,474	5,614,671	9,198,577	6,607,136
Sand and sandstone (finely ground) do	46,314	339,211	37,935	296,649
Sand-lime brick thousands	(1 3)	(1 3)	------------	------------
Silica (quartz) short tons	(1)	(1)	(1)	(1)
Stone do	[10] 9,007,420	[10] 8,005,576	10,306,140	9,426,808
Sulfuric acid [11] do	(1 6)	(1 6)	(1 6)	(1 6)
Miscellaneous [12]	------------	4,765,413	------------	2,618,287
Total value, eliminating duplications	------------	122,684,043	------------	131,025,104

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 National Bituminous Coal Commission.
5 Value is estimated from various sources and includes selling expenses.
6 Value not included in total value for State.
7 Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
8 Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
9 No canvass.
10 Exclusive of unclassified stone, value for which is included under "Miscellaneous."
11 From zinc-roasting operation.
12 Includes minerals indicated by "1", "2", and "10" above.

Mineral production of Oklahoma, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asphalt (native) short tons	(1)	(1)	(1)	(1)
Cement barrels	(1)	(1)	(1)	(1)
Chats short tons	1,134,500	$181,000	3,991,700	$410,675
Clay:				
Products (other than pottery and refractories)		(1 2)		2 583,334
Raw (sold by producers) short tons	4,361	53,548	(1)	(1)
Coal do	3 1,540,303	3 3,500,000	3 1,600,295	4 3,841,000
Gypsum do	5 156,545	(1 5)	6 159,639	6 266,091
Lead do	25,427	2,339,284	29,840	3,521,120
Mineral waters gallons sold	(7)	(7)	(7)	(7)
Natural gas M cubic feet	280,481,000	28,847,000	296,260,000	32,039,000
Natural gasoline gallons	418,591,000	17,516,000	492,290,000	20,272,000
Ores (crude), etc.:				
Zinc short tons	6,132,600	(8)	6,644,400	(8)
Zinc-lead do	2,953,000	(8)	3,787,600	(8)
Petroleum barrels	206,555,000	232,100,000	228,839,000	283,500,000
Pumice short tons	(1)	(1)	(1)	(1)
Salt do	(1)	(1)	(1)	(1)
Sand and gravel do	1,338,362	514,370	934,499	414,495
Stone do	1,213,570	1,131,536	1,098,790	1,149,624
Sulfuric acid 9 do	(1 10)	(1 10)	(1 10)	(1 10)
Tripoli do	(1)	(1)	(1)	(1)
Zinc do	129,175	12,917,500	135,696	17,640,480
Miscellaneous 11		6,563,603		4,338,213
Total value, eliminating duplications		305,191,649		367,444,222

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
4 Value is estimated from various sources and includes selling expenses.
5 Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
6 Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
7 No canvass.
8 Not valued as ore; value of recoverable metal content included under the metals.
9 From zinc smelting.
10 Value not included in total value for State.
11 Includes minerals indicated by "1" above.

Mineral production of Oregon, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Cement ... barrels	(1)	(1)	(1)	(1)
Chromite ... long tons			288	$880
Clay:				
Products (other than pottery and refractories)		[2] $411,238		[2] 430,884
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	(1 3)	(1 3)	(1 3)	(1 4)
Copper ... pounds	574,000	52,808	820,000	99,220
Diatomite ... short tons	(1)	(1)	(1)	(1)
Gems and precious stones		(5)		(5)
Gold ... troy ounces	60,753	2,126,355	52,662	1,843,170
Lead ... short tons	79	7,268	109	12,862
Lime ... do	(1)	(1)	(1)	(1)
Mercury ... flasks (76 pounds)	4,126	329,750	4,264	384,527
Mineral waters ... gallons sold	(5)	(5)	(5)	(5)
Ores (crude), etc.:				
Copper ... short tons	1,002	(6)	2,796	(6)
Dry and siliceous (gold and silver) ... do	135,336	(6)	74,401	(6)
Lead ... do			3	(6)
Lead-copper ... do			30	(6)
Platinum and allied metals ... troy ounces	68	3,228	43	2,452
Pumice ... short tons			(1)	(1)
Sand and gravel ... do	2,315,468	881,687	2,490,872	1,074,907
Silver ... troy ounces	85,061	65,880	60,564	46,846
Stone ... short tons	2,463,910	1,977,606	[7] 2,010,490	[7] 1,442,916
Zinc ... do	61	6,100	24	3,120
Miscellaneous [8]		1,219,055		1,267,926
Total value, eliminating duplications		7,080,975		6,609,710

1 Value included under "Miscellaneous."
2 Figures obtained through cooperation with Bureau of the Census.
3 According to National Bituminous Coal Commission.
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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement ....barrels..	[1] 22,527,491	[1] $33,235,017	[1] 22,952,603	[1] $31,917,831
Clay:				
Products (other than pottery and refractories)	....	[2] 10,305,064	....	[2] 11,713,891
Raw (sold by producers) ....short tons..	818,630	1,989,823	875,869	2,245,001
Coal:				
Anthracite ....do....	54,579,535	227,003,538	51,856,433	197,598,849
Bituminous ....do....	[3] 109,887,470	[3] 207,548,000	[3] 111,002,289	[4] 228,665,000
Coke ....do....	13,784,110	[5] 54,209,459	16,260,310	[5] 65,841,452
Copper [6] ....pounds..	(7)	(7)	(7)	(7)
Feldspar (crude) ....long tons..	144	828	(7)	(7)
Ferro-alloys ....do....	336,889	[5] 30,465,371	428,582	[5] 42,548,365
Gems and precious stones	....	(8)	....	(8)
Gold [6] ....troy ounces..	890	31,150	1,348	47,180
Iron:				
Ore—				
Sold to furnaces ....long tons..	1,104,454	2,208,908	(7)	(7)
Sold for paint ....do....	(7)	(7)	(7)	(7)
Pig ....do....	9,379,615	[5] 176,552,170	11,036,467	[5] 239,838,942
Lime ....short tons..	661,464	4,644,027	692,935	5,117,733
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..	110,362,000	42,874,000	115,928,000	41,842,000
Natural gasoline ....gallons..	14,267,000	722,000	13,940,000	701,000
Peat ....short tons..	(7)	(7)	(7)	(7)
Petroleum ....barrels..	17,070,000	41,450,000	19,189,000	49,300,000
Sand and gravel ....short tons..	6,241,404	5,814,440	7,715,962	7,587,013
Sand and sandstone (finely ground) ....do....	(7)	(7)	(7)	(7)
Sand-lime brick ....thousands..	....	....	(2 7)	(2 7)
Silver [6] ....troy ounces..	8,118	6,287	9,497	7,346
Slate	....	2,900,013	....	2,735,744
Stone ....short tons..	[9] 15,814,260	[9] 17,900,502	16,091,160	17,251,160
Sulfuric acid (60° Baumé) [10] ....do....	233,431	[5] 2,075,202	263,341	[5] 2,456,972
Talc ....do....	(7)	(7)	(7)	(7)
Tripoli (rottenstone) ....do....	150	4,500	200	4,800
Miscellaneous [11]	....	8,313,981	....	11,502,727
Total value, eliminating duplications	....	599,457,486	....	599,817,364

[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 National Bituminous Coal Commission.
[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. The quantity of such ore was 1,267,484 short tons in 1936; it is included as iron ore produced. Bureau of Mines not at liberty to publish figures for 1937.
[7] Value included under "Miscellaneous."
[8] No canvass.
[9] Exclusive of marble, value for which is included under "Miscellaneous."
[10] From zinc smelting.
[11] Includes minerals indicated by "1", "7", and "9" above.

Mineral production of Rhode Island, 1936–37

Product	1936		1937	
	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..	275,275	$143,457	370,614	$296,535
Stone ....do....	[5] 176,450	[5] 596,651	[5] 113,990	[5] 477,729
Miscellaneous [6]	....	1,741,120	....	1,492,693
Total value, eliminating duplications	....	929,103	....	862,710

[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 limestone, value for which is included under "Miscellaneous."
[6] Includes minerals indicated by "1" and "5" above.

Mineral production of South Carolina, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Clay:				
Products (other than pottery and refractories)		[1] $1,127,892		[1] $1,185,606
Raw (sold by producers) short tons	128,464	968,097	129,405	1,056,696
Copper pounds			1,500	182
Gold troy ounces	287	10,059	2,483	86,890
Lime short tons			(2)	(2)
Mica:				
Scrap do	(2)	(2)	(2)	(2)
Sheet pounds	(2)	(2)	(2)	(2)
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Ore (dry and siliceous) (gold and silver) short tons	12,535	(4)	21,585	(4)
Sand and gravel do	423,615	241,463	381,185	213,488
Silver troy ounces	50	39	624	483
Stone short tons	637,510	1,084,485	936,880	1,462,738
Tin (metallic equivalent) pounds			90	(2)
Miscellaneous [5]		627		16,242
Total value, eliminating duplications		3,432,662		4,022,325

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

Mineral production of South Dakota, 1936–37

Product	1936		1937	
	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	19,247	$129,087	(1)	(1)
Coal do	41,331	55,000	46,979	$63,000
Feldspar (crude) long tons	32,144	103,671	41,392	158,976
Gems and precious stones		(3)		(3)
Gold troy ounces	586,353	20,522,369	581,544	20,354,040
Gypsum short tons	(1 4)	(1 4)	(1 5)	(1 5)
Lime do	(1)	(1)	(1)	(1)
Lithium minerals do	1,241	34,273	1,357	36,206
Mica, scrap do	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Natural gas M cubic feet	9,000	3,000	10,000	3,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) short tons	1,549,146	(6)	1,597,178	(6)
Sand and gravel do	3,325,490	746,711	3,845,432	612,552
Sand-lime brick thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver troy ounces	144,448	111,875	139,638	108,010
Stone short tons	259,130	693,496	[7] 407,270	[7] 982,906
Tantalum ore (columbo-tantalite) pounds			13,376	11,307
Tin (metallic equivalent) short tons	(8)	(1)	1	1,000
Miscellaneous [9]		822,138		1,141,876
Total value, eliminating duplications		23,221,620		23,472,873

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] No canvass.
[4] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[5] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[6] Not valued as ore; value of recoverable metal content included under the metals.
[7] Exclusive of dimension sandstone, value for which is included under "Miscellaneous."
[8] 60 pounds.
[9] Includes minerals indicated by "1" and "7" above.

Mineral production of Tennessee, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Aluminum pounds	(1 2)	(1 2)	(1 2)	(1 2)
Barite short tons	(1)	(1)	(1)	(1)
Cement barrels	3,035,406	$4,741,701	3,013,817	$4,683,717
Clay:				
Products (other than pottery and refractories)		[3] 1,582,216		[3] 1,873,644
Raw (sold by producers) short tons	46,573	281,203	68,499	437,345
Coal do	[4] 5,108,195	[4] 9,460,000	[4] 5,212,471	[5] 10,373,000
Coke do	86,872	[2] 397,370	104,433	[2] 519,077
Copper pounds	(1)	(1)	(1)	(1)
Ferro-alloys long tons	22,159	[2] 1,538,326	24,068	[2] 1,669,779
Fuller's earth short tons			(1)	(1)
Gold troy ounces	410	14,350	263	9,205
Iron:				
Ore long tons	27,617	73,720	28,359	89,761
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	168,121	958,407	157,440	909,839
Manganese ore long tons	3,539	51,878	3,575	99,055
Manganiferous ore do	104	314	902	6,475
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	84,000	28,000	17,000	6,000
Ores (crude), etc.:				
Copper short tons	662,783	(7)	705,000	(7)
Zinc do	831,833	(7)	975,956	(7)
Zinc-lead do	18,000	(7)	11,300	(7)
Petroleum barrels	20,000	20,000	35,000	35,000
Phosphate rock long tons	641,599	2,580,432	(1)	(1)
Pyrites do	(1)	(1)	(1)	(1)
Sand and gravel short tons	2,243,283	1,549,660	2,366,646	1,458,543
Silica (quartz) do	(1)	(1)	(1)	(1)
Silver troy ounces	50,330	38,980	49,057	37,946
Slate		(1)		(1)
Stone short tons	[8] 2,840,980	[8] 4,067,227	[8] 2,720,750	[8] 3,979,159
Sulfuric acid [9] do	(1 2)	(1 2)	(1 2)	(1 2)
Tripoli do			(1)	(1)
Zinc do	(1)	(1)	(1)	(1)
Miscellaneous [10]		18,952,735		29,805,470
Total value, eliminating duplications		31,121,865		34,893,847

[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 National Bituminous Coal Commission.
[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 granite in 1936 and of crushed sandstone in 1937, value for which is included under "Miscellaneous."
[9] From copper smelting.
[10] Includes minerals indicated by "1" and "8" above.

Mineral production of Texas, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Asphalt (native) short tons	94,560	$281,969	96,671	$300,531
Barite do			(1)	(1)
Cement barrels	5,853,609	10,076,934	6,687,719	11,488,866
Clay:				
Products (other than pottery and refractories)		[2] 2,789,010		[2] 3,242,832
Raw (sold by producers) short tons	29,041	211,287	51,486	347,244
Coal:				
Bituminous do	[3] 40,298	[3] 105,000	[3] 44,060	[4] 122,000
Lignite do	802,326	624,000	866,292	683,000
Copper pounds	53,000	4,876	320,000	38,720
Fuller's earth short tons	46,855	462,656	49,500	473,408
Gems and precious stones		(5)		(5)
Gold troy ounces	613	21,455	562	19,670
Graphite, crystalline pounds			(1)	(1)
Gypsum short tons	[6] 257,773	[6] 2,931,741	[7] 280,807	[7] 313,563
Helium cubic feet	(1 8)	(1 8)	(1 8)	(1 8)
Lead short tons	468	43,010	395	46,610
Lime do	51,281	470,510	49,135	440,069
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	734,561,000	113,929,000	854,561,000	132,166,000
Natural gasoline gallons	520,547,000	19,670,000	615,281,000	24,329,000
Ores (crude), etc.:				
Copper short tons			3,949	(9)
Dry and siliceous (gold and silver) do	104,935	(9)	116,153	(9)
Lead do	55	(9)		
Lead-copper do			43	(9)
Petroleum barrels	427,411,000	449,400,000	510,318,000	594,500,000
Salt short tons	316,006	615,815	364,780	623,037
Sand and gravel do	6,425,681	3,929,265	7,186,717	4,058,566
Sand-lime brick thousands	(1 2)	(1 2)		
Silver troy ounces	1,361,459	1,054,450	1,325,660	1,025,398
Sodium sulfate (natural) short tons	(1)	(1)	(1)	(1)
Stone do	2,048,360	2,323,715	[10] 2,149,320	[10] 2,218,643
Sulfur long tons	1,630,719	29,352,944	2,030,315	36,545,670
Miscellaneous [11]		345,851		287,558
Total value, eliminating duplications		638,643,488		813,270,605

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] No canvass.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] For details of production in fiscal years see chapters on Helium.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] Exclusive of marble, value for which is included under "Miscellaneous."
[11] Includes minerals indicated by "1" and "10" above.

Mineral production of Utah, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Arsenious oxide ... short tons	(1)	(1)	(1)	(1)
Asphalt (native) ... do	33,731	$840,103	38,171	$983,628
Bitumen, natural sulfonated ... do			(1)	(1)
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 567,642		[2] 619,950
Raw (sold by producers) ... short tons	(1)	(1)	(1)	(1)
Coal ... do	[3] 3,246,565	[3] 6,619,000	[3] 3,809,476	[4] 8,648,000
Coke ... do	129,963	(1 5)	156,316	(1 5)
Copper ... pounds	252,434,000	23,223,928	411,988,000	49,850,548
Diatomite ... short tons			150	1,500
Fluorspar ... do	700	(1)	431	(1)
Gems and precious stones		(6)		(6)
Gold ... troy ounces	223,444	7,820,540	322,759	11,296,565
Gypsum ... short tons	[7] 40,275	[7] 266,854	[8] 46,197	[8] 46,197
Iron:				
Ore—				
Sold to furnaces ... long tons	153,923	375,475	188,794	(1)
Sold for paint ... do	268	(1)		
Pig ... do	(1 5)	(1 5)	(1 5)	(1 5)
Lead ... short tons	69,886	6,429,512	89,458	10,556,044
Lime ... do	30,986	272,431	46,670	319,517
Manganese ore ... long tons	1,635	(1)	32	297
Manganiferous ore ... do	2,974	19,931	3,436	25,771
Mercury ... flasks (76 pounds)	25	1,998		
Mica, scrap ... short tons			(1)	(1)
Molybdenum ... pounds	(1)	(1)	4,804,002	(1)
Natural gas ... M cubic feet	92,000	19,000	2,366,000	471,000
Natural gasoline ... gallons			367,000	19,000
Ores (crude), etc.:				
Copper ... short tons	13,774,589	(9)	23,197,017	(9)
Dry and siliceous (gold and silver) ... do	572,821	(9)	485,152	(9)
Lead ... do	88,080	(9)	152,691	(9)
Zinc ... do			173	(9)
Zinc-lead ... do	562,402	(9)	743,242	(9)
Petroleum ... barrels	3,000	5,000	2,000	3,000
Potassium salts ... short tons	(1)	(1)	(1)	(1)
Salt ... do	56,480	168,706	69,696	205,328
Sand and gravel ... do	2,267,808	1,352,296	2,345,451	1,158,387
Silver ... troy ounces	9,997,645	7,743,176	12,869,117	9,954,262
Stone ... short tons	422,230	230,067	453,540	315,985
Sulfur ... long tons	(1)	(1)	(1)	(1)
Sulfuric acid [10] ... short tons	(1 5)	(1 5)	(1 5)	(1 5)
Tungsten ore (60-percent concentrates) ... do			24	(1)
Uranium ores ... do	(1)	(1)	(1)	(1)
Zinc ... do	36,192	3,619,200	48,001	6,240,130
Miscellaneous [11]		4,390,617		8,186,541
Total value, eliminating duplications		61,209,302		105,652,422

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] No canvass.
[7] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[8] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[9] Not valued as ore; value of recoverable metal content included under the metals.
[10] From copper smelting.
[11] Includes minerals indicated by "1" above.

Mineral production of Vermont, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Asbestos short tons	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)		(1 2)		(1 2)
Lime short tons	42,505	$278,591	56,585	$388,885
Mineral waters gallons sold	(3)	(3)	(3)	(3)
Sand and gravel short tons	(1)	(1)	636,710	306,892
Slate		1,265,608		1,431,798
Stone short tons	[4] 266,130	[4] 3,637,838	[4] 194,770	[4] 4,215,766
Talc do	45,746	410,045	41,118	384,474
Miscellaneous [5]		633,314		314,732
Total value, eliminating duplications		6,225,396		7,042,547

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."
5 Includes minerals indicated by "1" and "4" above.

Mineral production of Virginia, 1936–37

Product	1936 Quantity	1936 Value	1937 Quantity	1937 Value
Barite......short tons..	(1)	(1)	(1)	(1)
Cement......barrels..	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)......	....	[2] $1,984,356	....	[2] $2,544,596
Raw (sold by producers)......short tons..	(1)	(1)	(1)	(1)
Coal......do....	[3] 11,661,636	[3] 20,278,000	[3] 13,795,239	[4] 27,177,000
Coke......do....	191,331	[5] 811,894	240,425	[5] 1,180,800
Copper......pounds..	....	....	1,000	121
Feldspar (crude)......long tons..	20,459	114,807	22,175	125,396
Ferro-alloys......do....	(1 5)	(1 5)	(1 5)	(1 5)
Gold......troy ounces..	909	31,814	1,396	48,863
Gypsum......short tons..	(1 6)	(1 6)	(1 7)	(1 7)
Iron:				
Ore......long tons..	1,206	5,796	518	(1)
Pig......do....	(1 5)	(1 5)	(1 5)	(1 5)
Kyanite......short tons..	(8)	(8)	(8)	(8)
Lead......do....	(1)	(1)	(1)	(1)
Lime......do....	174,484	1,104,982	192,493	1,248,479
Manganese ore......long tons..	1,361	20,772	2,265	38,561
Manganiferous ore......do....	874	6,398	1,170	9,663
Marl, calcareous......short tons..	6,090	6,874	(1)	(1)
Mica:				
Scrap......do....	(1)	(1)	(1)	(1)
Sheet......pounds..	(1)	(1)	(1)	(1)
Millstones......	....	5,151	....	(1)
Mineral waters......gallons sold..	(9)	(9)	(9)	(9)
Ores (crude), etc.:				
Dry and siliceous (gold and silver) short tons..	6,196	(10)	10,169	(10)
Zinc-lead......do....	485,634	(10)	577,300	(10)
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....	2,735,972	1,767,268	2,398,462	1,753,865
Sand and sandstone (finely ground)......do....	(1)	(1)	(1)	(1)
Silica (quartz)......do....	....	....	369	1,063
Silver......troy ounces..	96	75	111	86
Slate......	....	[11] 259,921	....	355,467
Stone [12]......short tons..	[13] 4,488,760	[13] 4,560,554	[13] 5,061,660	[13] 5,399,137
Talc and ground soapstone [12]......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 [14]......	....	10,162,102	....	11,137,832
Total value, eliminating duplications......	....	37,295,168	....	46,019,085

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Value not included in total value for State.
[6] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[7] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[8] Figures not available.
[9] No canvass.
[10] Not valued as ore; value of recoverable metal content included under the metals.
[11] Exclusive of granules, etc., value for which is included under "Miscellaneous."
[12] Soapstone used as dimension stone included in figures for stone.
[13] Exclusive of marble, value for which is included under "Miscellaneous."
[14] Includes minerals indicated by "1," "11," and "13" above.

Mineral production of Washington, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Antimony ore ..... short tons	(1)	(1)	(1)	(1)
Cement ..... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)	.....	[2] $986,884	.....	[2] $1,028,804
Raw (sold by producers) ..... short tons	43,968	104,490	49,858	91,279
Coal ..... do	[3] 1,812,104	[3] 5,504,000	[3] 2,001,449	[4] 6,325,000
Coke ..... do	28,680	[5] 172,368	14,656	[5] 87,936
Copper ..... pounds	204,000	18,768	128,000	15,488
Diatomite ..... short tons	880	10,579	1,932	32,803
Gold ..... troy ounces	12,217	427,609	36,310	1,270,850
Iron ore ..... long tons	9,082	36,361	10,010	32,859
Lead ..... short tons	840	77,280	2,830	333,940
Lime ..... do	36,638	340,724	65,272	647,692
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)
Natural gas ..... M cubic feet	141,000	99,000	143,000	100,000
Olivine ..... short tons	(7)	(7)	(7)	(7)
Ores (crude), etc.:				
Copper ..... do	11,993	(8)	6,631	(8)
Dry and siliceous (gold and silver) ..... do	45,167	(8)	181,604	(8)
Lead ..... do	106	(8)	445	(8)
Zinc-lead ..... do	76,169	(8)	106,146	(8)
Peat ..... do	1,052	14,595	(1)	(1)
Pulpstones ..... do	(1)	(1)	(1)	(1)
Sand and gravel ..... do	8,970,849	5,942,080	9,376,644	6,818,154
Sand-lime brick ..... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Silver ..... troy ounces	66,900	51,814	126,304	97,696
Stone ..... short tons	[9] 2,321,710	[9] 2,279,405	2,027,420	1,909,604
Talc ..... do	462	1,805	406	6,754
Tungsten ore (60-percent concentrates) ..... do	48	36,294	64	(1)
Zinc ..... do	4,403	440,300	4,116	535,080
Miscellaneous [10]	.....	6,549,468	.....	7,412,254
Total value, eliminating duplications	.....	22,921,456	.....	26,658,257

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Bromine pounds	636, 290	$97, 235	816, 375	$132, 494
Calcium chloride short tons	12, 558	71, 045	16, 681	78, 754
Cement barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] 2, 168, 821		[2] 2, 745, 183
Raw (sold by producers) short tons	55, 767	99, 709	48, 619	94, 413
Coal do	[3] 117, 925, 706	[3] 193, 443, 000	[3] 118, 646, 343	[4] 223, 055, 000
Coke do	1, 933, 441	[5] 5, 997, 699	2, 097, 380	[5] 7, 054, 186
Ferro-alloys long tons	(1 5)	(1 5)	(1 5)	(1 5)
Grindstones and pulpstones short tons	2, 504	157, 945	3, 241	217, 929
Iron, pig long tons	669, 208	(1 5)	685, 086	(1 5)
Lime short tons	253, 339	1, 601, 213	250, 205	1, 617, 040
Magnesium salts (natural) pounds			(1)	(1)
Manganese ore long tons	178	3, 017	1, 800	36, 461
Marl, calcareous short tons	(1)	(1)	(1)	(1)
Mineral waters gallons sold	(6)	(6)	(6)	(6)
Natural gas M cubic feet	138, 076, 000	54, 788, 000	149, 084, 000	58, 639, 000
Natural gasoline gallons	44, 389, 000	2, 306, 000	50, 379, 000	2, 528, 000
Petroleum barrels	3, 847, 000	8, 200, 000	3, 845, 000	8, 800, 000
Salt short tons	117, 401	719, 382	128, 715	713, 421
Sand and gravel do	3, 755, 022	2, 794, 944	2, 407, 911	2, 349, 356
Sand and sandstone (finely ground) do	(1)	(1)	(1)	(1)
Stone do	[7] 2, 970, 700	[7] 2, 624, 157	[7] 3, 510, 040	[7] 3, 696, 556
Sulfuric acid [8] do	(1 5)	(1 5)	(1 5)	(1 5)
Miscellaneous [9]		22, 811, 425		23, 041, 891
Total value, eliminating duplications		271, 501, 941		306, 660, 947

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[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 basalt in 1936 and of dimension sandstone in 1937, value for which is included under "Miscellaneous."
[8] From zinc smelting.
[9] Includes minerals indicated by "1" and "7" above.

Mineral production of Wisconsin, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay products (other than pottery and refractories)		[2] $343,520		[2] $557,152
Coke ... short tons	(1 3)	(1 3)	(1 3)	(1 3)
Iron ore—				
Sold to furnaces ... long tons	918,935	2,568,129	1,419,810	4,473,942
Sold for paint ... do	326	(1)	500	(1)
Lead ... short tons	904	83,168	1,091	128,738
Lime ... do	54,978	470,964	59,536	508,536
Manganiferous ore ... long tons	405	1,807		
Marl, calcareous ... short tons	22,012	10,806	9,460	2,914
Mineral waters ... gallons sold	(4)	(4)	(4)	(4)
Ores (crude), etc.:				
Zinc ... short tons	55,000	(5)	5,000	(5)
Zinc-lead ... do	229,800	(5)	280,000	(5)
Pyrites ... long tons	(1)	(1)	(1)	(1)
Sand and gravel ... short tons	8,192,376	3,513,683	7,531,031	3,291,944
Sand and sandstone (finely ground) ... do	(1)	(1)	(1)	(1)
Sand-lime brick ... thousands	(1 2)	(1 2)	(1 2)	(1 2)
Stone ... short tons	[6] 3,171,100	[6] 3,967,452	3,331,670	4,284,003
Sulfuric acid [7] ... do	(1 3)	(1 3)	(1 3)	(1 3)
Zinc ... do	8,126	812,600	6,938	901,940
Miscellaneous [8]		6,028,225		6,189,627
Total value, eliminating duplications		13,277,983		15,228,024

[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] Exclusive of basalt, value for which is included under "Miscellaneous."
[7] From zinc-roasting operation.
[8] Includes minerals indicated by "1" and "6" above.

Mineral production of Wyoming, 1936–37

Product	1936		1937	
	Quantity	Value	Quantity	Value
Cement ... barrels	(1)	(1)	(1)	(1)
Clay:				
Products (other than pottery and refractories)		[2] $127,590		(1 2)
Raw (sold by producers) ... short tons	55,090	520,852	67,958	$659,111
Coal ... do	[3] 5,780,590	[3] 11,200,000	[3] 5,918,359	[4] 11,600,000
Gold ... troy ounces	1,964	68,754	1,776	62,160
Gypsum ... short tons	(1 5)	(1 5)	(1 6)	(1 6)
Iron ore ... long tons	507,278	(1)	707,907	(1)
Mineral waters ... gallons sold	(7)	(7)	(7)	(7)
Natural gas ... M cubic feet	29,322,000	4,564,000	31,023,000	4,997,000
Natural gasoline ... gallons	33,894,000	1,752,000	33,548,000	1,718,000
Ores (crude), etc.:				
Dry and siliceous (gold and silver) ... short tons	344	(8)	17	(8)
Petroleum ... barrels	14,582,000	13,700,000	19,166,000	18,860,000
Potassium salts ... short tons			(1)	(1)
Sand and gravel ... do	2,046,271	768,756	2,438,367	886,901
Silver ... troy ounces	1,113	862	203	157
Sodium sulfate (natural) ... short tons	(1)	(1)	(1)	(1)
Stone ... do	332,360	308,276	[9] 342,710	[9] 287,957
Tin (metallic equivalent) ... do			2	2,000
Vermiculite ... do	(1)	(1)	(1)	(1)
Miscellaneous [10]		1,487,171		2,014,622
Total value, eliminating duplications		34,498,261		41,087,908

[1] Value included under "Miscellaneous."
[2] Figures obtained through cooperation with Bureau of the Census.
[3] According to National Bituminous Coal Commission.
[4] Value is estimated from various sources and includes selling expenses.
[5] Gypsum mined; value as sold (crude and calcined). Comparable value for 1937 not available.
[6] Gypsum mined; value of crude at mine as reported by producers. Comparable value for earlier years not available.
[7] No canvass.
[8] Not valued as ore; value of recoverable metal content included under the metals.
[9] Exclusive of basalt, value for which is included under "Miscellaneous."
[10] Includes minerals indicated by "1" and "9" above.

WORLD PRODUCTION OF MINERALS AND ECONOMIC ASPECTS OF INTERNATIONAL MINERAL POLICIES

By J. S. McGrath

SUMMARY OUTLINE

Although political developments during 1938 deserve paramount consideration in any world review of the year, an analysis of the gains and losses in terms of mineral raw materials sustained by certain countries illustrates the relative importance of political or commercial control of adequate mineral resources to the economic well-being of any nation.

Since the world depression reached its lowest level in 1933, policies adopted by many countries, but especially by certain major industrial powers, have been directed toward improvement of their national economic structures through whatever means that objective might be accomplished in the light of constant changes in world conditions. Throughout 1938 determined efforts in this direction on the part of Germany and Italy, for example, to attain approximate economic self-sufficiency conflicted with national economic policies of other industrial nations that are more nearly self-sufficient in their domestic supplies of raw materials.

Economic devices, governmentally inspired and administered, such as foreign exchange controls, quota restrictions, production-consumption controls, export-import license requirements, bilateral trade agreements, and barter trade, adopted by many countries during the past few years were applied in many instances more rigidily and extensively during 1938, especially in Germany, Italy, and Japan.

Although national policies in effect during 1938 in the aforementioned countries may have had a more powerful world-wide influence or significance, certain developments in other countries also directly affected world production of and international trade in large tonnages of a diversified group of essential and in most instances strategic mineral raw materials. A number of examples may be cited. On March 19, 1938, the Mexican Government announced the expropriation of Mexican properties belonging to American and British companies engaged in the production of petroleum in Mexico on the ground that these concerns had engaged in activities that were damaging to the national economy of Mexico; no satisfactory settlement was reached by the end of the year. The civil strife in Spain that began in July 1936 continued throughout 1938, and while production of and foreign trade in mercury, lead, and iron and copper pyrites, of which Spain is an important producer and exporter, did not cease, the difficulties of shipment were more pronounced during 1938. Disturbed internal conditions in China throughout 1938 affected international trade in tungsten and antimony in a manner somewhat similar to that evident in the Spanish situation.

Conflicting foreign trade policies evident.—Changes in economic and political conditions throughout the world during the past few years explain, in part at least, the adoption by certain industrial countries that lack adequate domestic supplies of raw materials of national policies whose objective is maximum self-sufficiency and minimum dependence on foreign countries. Germany and Italy are outstanding examples of countries that have adopted this theory of economic self-preservation. Opposed to and in conflict with this planned and governmental-directed renunciation of free trade is the policy that prevails in other major industrial countries of the world and that is based on the use of comparative cost advantages in the operation of international trade. The latter policy naturally places the countries involved in a position somewhat dependent on one another as regards their national economic welfare. The reciprocal trade program of the United States, as provided for in the Trade Agreements Act of June 12, 1934, and extended for 3 years from March 1, 1937, may be accepted as representing the most constructive policy in operation during 1938 directed toward the solution of problems confronting all nations that rely to any extent on foreign trade as an essential factor in their national economy.

The Central-European situation during 1938, with emphasis on the mineral wealth gained by Germany, Poland, and Hungary at the expense of the former Republics Austria and Czechoslovakia, represents an excellent example of the influence on a country's national economy of the possession or lack of adequate domestic supplies of essential mineral raw materials and, with particular reference to Germany, the world-wide effect of policies, whose expressed objective is economic self-sufficiency.

GERMANY

Germany's trade policy.—Germany is an outstanding example among industrial nations of a country whose domestic economy and industrial progress depend on foreign trade, with maximum exports of manufactured products offsetting essential imports of raw materials. In the absence of adequate foreign credits, Germany has developed a foreign trade system of purchasing required raw materials from countries willing to accept German goods as payment. This barter policy during the past few years has resulted in a shifting of the positions of Germany's foreign customers, and while trade with other major industrial countries has declined trade with other countries that produce certain raw materials and import finished products has improved. This shift in foreign trade, and the extent of Germany's dependence on imported raw materials, may be illustrated by the following examples:

Imports of certain deficient minerals into Germany in 1932 and 1938

Commodity and country of origin	1932 Metric tons	1932 Percent of total	1938 Metric tons	1938 Percent of total	Increase in 1938, percent
Bauxite:					
France	69,564	35	92,272	8	----------
Hungary	68,228	34	363,256	31	----------
Netherland India	----------	----------	192,668	16	----------
Yugoslavia	39,831	20	348,068	29	----------
Other countries	23,108	11	188,383	16	----------
	200,731	100	1,184,647	100	490
Chromite:					
British South Africa	17,942	42	73,393	42	----------
Turkey	11,565	27	52,584	30	----------
Yugoslavia	2,534	6	12,693	7	----------
Other countries	10,612	25	37,736	21	----------
	42,653	100	176,406	100	314
Copper, rough:					
British South Africa	25,675	19	76,500	28	----------
Belgian Congo	18,145	14	39,931	15	----------
Belgium	16,670	13	5,932	2	----------
Chile	17,486	13	40,007	15	----------
United States	21,356	16	62,330	23	----------
Yugoslavia	13,970	11	7,011	2	----------
Other countries	17,826	14	40,689	15	----------
	131,128	100	272,400	100	109
Iron ore:					
Algeria	146,719	4	755,454	4	----------
Belgium-Luxemburg	2,335	(1)	1,718,049	8	----------
France	715,609	21	5,056,121	23	----------
Newfoundland	191,156	6	1,121,515	5	----------
Spain	460,071	13	1,082,551	5	----------
Spanish Morocco	----------	----------	724,549	3	----------
Sweden	1,577,740	46	8,992,331	41	----------
Other countries	357,978	10	2,476,969	11	----------
	3,451,608	100	21,927,539	100	535
Manganese ore:					
Brazil	----------	----------	47,769	11	----------
British India	5,667	5	17,226	4	----------
British South Africa	----------	----------	268,044	63	----------
Egypt	7,601	7	----------	----------	----------
U. S. S. R.	85,338	80	60,925	14	----------
Other countries	8,173	8	31,821	8	----------
	106,779	100	425,785	100	299

[1] 0.07 percent.

The general decline in business in many of the minor industrial countries during the past few years has been a factor favorable to Germany in the development of its present foreign trade system. The dependence of certain nonindustrial countries on imports of manufactured products and their ability to furnish certain essential raw materials have resulted in the establishment of a definite barter relation between import and export prices in Germany that cannot be reconciled with prevailing world market prices for the products involved. With declining export proceeds, Germany has been able to maintain its imports of raw materials at a relatively high level through the medium of bilateral trade agreements with numerous countries willing to accept manufactured products in return for raw materials required by German industry. According to the German Institute for Business Research, "The barter relation between export and import prices grew steadily worse during the period from 1932 to the spring of 1937 but since then, as a result of the world business decline, the relation has become more favorable to Germany."

Austria's contribution to the mineral wealth of Germany.—What did Germany gain in mineral wealth that may facilitate its drive toward self-sufficiency when on March 13, 1938, a decree was issued declaring Austria to be a State of Greater Germany? At that time, in consequence of the World War, Austria already had lost many important mining districts to Czechoslovakia, Yugoslavia, Poland, and Italy. Like Germany, Austria had depended largely on its export trade to furnish the means, in terms of cash or foreign credits, for obtaining deficient mineral products. However, unlike Germany, where the opposite attitude is an outstanding feature of the New Plan announced in the autumn of 1934 and the Four-Year Plan inaugurated toward the end of 1936, Austria made no serious effort to replace essential imports by substitute materials of domestic origin or to develop under Government direction low-grade, noncommercial domestic mineral deposits. Austria for some years has produced an exportable surplus of iron ore, magnesite, graphite, and talc. The iron ore production—nearly 2 million tons in 1937—without doubt can be more than doubled. One of the most difficult barriers Germany has to hurdle in its drive toward self-sufficiency is the inability to obtain an adequate supply of iron ore from domestic sources. In 1937 Germany imported 20,620,876 metric tons of iron ore and during 1938, 21,927,539 metric tons; the 1938 figure indicates clearly Germany's dependence on foreign sources of supply, as Austria's output after March 1938 was "of domestic origin." The iron ore reserves of Austria probably represent the most valuable mineral asset acquired by Germany from that country. Not unimportant, however, was the acquisition of Austria's magnesite deposits; the annual output has for years maintained Austria in the position of world's largest producer of this mineral. In 1937 Germany imported 178,756 metric tons of magnesite, all grades, while Austria produced over 400,000 tons of crude magnesite and supplied Germany with less than 40 percent of the latter's total annual imports; obviously Germany should be now self-sufficient, or virtually so, in its domestic magnesite reserves. Moreover, with reference to graphite, Germany apparently has become self-sufficient through acquisition of Austria's resources. In 1937 Germany imported 7,953 metric tons of crude graphite while Austria produced more than 23,000 tons; in 1938 Greater Germany imported only 3,750 tons. Germany's imports of pig iron and ferro-alloys in 1937 were slightly less than Austria's total output, and it may be assumed that these items ultimately will disappear from the tables of essential German imports; imports in 1938 were 109,972 tons.

Mineral wealth gained by annexation of Sudetenland.—What economic advantages that involve mineral wealth were gained by Germany through annexation in October 1938 of the Sudeten areas in the Provinces of Bohemia and Moravia, Czechoslovakia? The Czech Republic, which came into existence in October 1918, inherited over four-fifths of the industrial resources of the former Austro-Hungarian Empire, including the lead-silver, iron ore, coal, lignite, and radium mines of Bohemia, the iron ore and oil fields of Slovakia, and the southern tip of the Silesia coal-mining district. The determination of Germany, apparent early in 1938, to acquire at least a portion of Czechoslovakia culminated first in the Munich Agreement of September 30, 1938, which approved the partition of Czechoslovakia, and then in its final dissolution in March 1939. Before the end of October 1938 a new German-Czech border was defined. The economic advantages to Germany were as yet questionable by the end of the year. The heavy industries, especially the Skoda armament works—the largest in Europe outside of Germany—remained just inside the Czech frontier as of December 31, 1938. However, about 94 percent of the lignite produced annually and about 12 percent of its coal output were lost to Germany by Czechoslovakia. Losses to Poland and Hungary will be summarized later. Germany's acquisition of the lignite and coal deposits in northwest Bohemia has little economic importance, as there was already within Germany a sufficiency of both. Czechoslovak lignite deposits are, however, of much higher grade than is German "brown coal."

In addition to the lignite and coal resources lost by Czechoslovakia during 1938, the State-owned radium mine at Joachimstal, Bohemia, the high-grade china clay deposits, and virtually all the china and porcelain plants of western Bohemia now belong to Germany. In 1937 Germany imported 236,898 tons of china clay, of which 75 percent originated in Czechoslovakia. The total output of Czechoslovakia in 1937 was about 360,000 tons; in 1938 Germany imported only 189,310 tons. It seems probable that this item may likewise disappear from the list of essential German imports.

German annexation of Czech Provinces of Bohemia and Moravia.—On March 16, 1939, the Republic of Czechoslovakia lost its identity as an independent State; the Province of Slovakia declared its independence, the Provinces of Bohemia and Moravia were annexed by Germany, and the Province of Ruthenia (Carpatho-Ukraine) was annexed by Hungary. This dissolution of Czechoslovakia added little to Germany's mineral resources, but acquisition of the Skoda armament works at Plzeň and those in Brno represents significant gains to German industry.

The mineral wealth acquired by Germany through annexation of Austria in March 1938, the Sudetenland of Czechoslovakia in October 1938, and the Czech Provinces of Bohemia and Moravia in March 1939 has relatively minor importance in the effort being made to achieve self-sufficiency. The additional territory gained would appear to make more pronounced Germany's deficiencies in the nonferrous metal group and in nonmetals, especially petroleum products.

Trade agreement with Rumania.—Soon after the dismemberment of Czechoslovakia, Germany negotiated a trade agreement with Rumania that was signed on March 23, 1939. This agreement is significant because of Germany's dependence on imports of petroleum products and the fact that Rumania ranks about sixth among the petroleum-producing countries of the world. The agreement provides for German-Rumanian collaboration in matters pertaining to economic planning, and from that portion of the text published economic penetration of Rumania by Germany appears inevitable. For example, the agreement stipulates that German-Rumanian companies will be organized to exploit Rumanian resources of petroleum, pyrites, chrome, manganese, and bauxite; German and Rumanian banks will collaborate in financing such mixed enterprises; and Germany will collaborate in the construction and improvement of Rumanian railways, waterways, and other public utilities. The agreement is for a 5-year period, and if not repudiated with 1 year's notice it will continue indefinitely.

Reliable but unofficial sources report that the agreement provides for an assignment to Germany of 40 percent of Rumania's exports of petroleum products. Gasoline has been the most important petroleum product exported by Rumania to Germany; should the afore-mentioned report be correct, Germany will have to depend on other foreign sources for only one-third or less of its motor-fuel requirements.

POLAND

Mineral wealth gained by partition of Czechoslovakia.—Although Sudeten territory lost by Czechoslovakia may be considered relatively unimportant to present-day German economy, the comparatively small area of about 500 square miles acquired by Poland represents a gain of paramount importance to Polish national economy. The acquisition by Poland in November 1938 of Trans-Olzan Silesia or the Olza district, a highly industrialized region containing high-grade coking-coal deposits and extensive iron and steel plants, undoubtedly will bring far-reaching benefits to the country. The predominant industries of this area are coal mining; the manufacture of iron, steel, and other metals, chemicals, and clothing; and the preparation of lumber—about 2,800 separate enterprises in all. About 75 percent of the coal and 40 percent of the steel produced formerly by Czechoslovakia came from this area.

Of the various branches of Polish industry that will benefit from the annexation of Trans-Olzan Silesia, coal mining and the iron and steel industry will gain most, the former increasing its annual output by 20 percent on the basis of 1937 figures and the latter by 55 percent in pig iron and 50 percent in steel.

Coal-mining industry.—The importance of the coal-mining industry in Trans-Olzan Silesia is based on extensive formations of coking coal. The deposits were the best and richest of the former Austro-Hungarian Empire, and the coking qualities of the coal prompted the establishment of important foundry and metal-manufacturing industries in this area.

The coal deposits occur in the Ostrawa-Karwina region, which forms a part of the extensive Upper Silesia coal basin, portions of which have been within the Republic of Poland since 1919, in Germany, and the remainder herein described in Czechoslovakia. The portion formerly held by Czechoslovakia and annexed by Poland in November 1938 represents one-seventh of the entire basin. The most important coal deposits of this area are centered around Karwina, Lazy, and Orlowa; the average depth of shafts is 600 meters. Coal reserves of Trans-Olzan Silesia are reported to be about 4 billion metric tons compared with 62 billion tons of former Poland; the developed reserves of the Trans-Olzan area are estimated at 250 million tons. During 1937 production in the area acquired by Poland totaled 7,352,000 metric tons as against a total Polish production of 36,000,000 tons in the same year. The coke production in 1937 was 1,156,100 metric tons as against a total Polish production of 2,126,000 tons. All coal mines in the region have modern equipment, and at least two-thirds of the coal mined is extracted by mechanical means. The coal produced in Trans-Olzan Silesia contains between 12,600 to 14,400 B. t. u. per pound and has a 65- to 80-percent yield of coke.

Various types of coke are produced in the area. Some of the plants producing special foundry coke are especially suitable for steel production, and there is a fuel coke whose quality is said to surpass that produced in Polish Upper Silesia.

Iron and steel industry.—Absorption of the extensive iron and steel plants and minor iron ore deposits in Trans-Olzan Silesia are of greater importance to Poland's national economy than the coal deposits acquired. The iron and steel industry of this area is based in part on iron ore deposits in the immediate neighborhood of foundries at Trzyniec. These deposits are chiefly low-grade ores containing about 30 percent iron. Annual output has not exceeded 150,000 metric tons. The industry therefore depends to a large extent on iron ore supplies from the former Province of Slovakia and on high-grade ores imported from Sweden and the Soviet Union. A well-equipped network of railways provides adequate transportation of coal and iron ore shipped from mines to industrial centers in this region.

The largest iron and steel foundry in Trans-Olzan Silesia, that at Trzyniec, is capitalized at $7,800,000, employs 5,500 workmen, and ranks among the largest European steel concerns. Founded in 1839, the plant belongs to a well-known Czechoslovak metallurgical trust, the controlling interest in which is held by the Schneider-Creusot interests of France; the latter concern also has a substantial interest in the large Skoda armament works of Czechoslovakia. This foundry produced approximately one-fourth of former Czechoslovakia's total production of iron and steel. As a member of the International Steel Export Cartel, its annual export quota has amounted to 50,000 metric tons of rolling-mill products equivalent to about 60,000 metric tons of raw steel. Since Poland's export quota as formerly fixed by the cartel was 300,000 metric tons of raw steel per year, it follows that Poland's aggregate steel exports will be increased by about 20 percent.

The Trzyniec foundry operates four blast furnaces in the production of pig iron, with an estimated annual capacity of 530,000 metric tons. Incorporation of the Trzyniec foundry into Poland will raise the country's annual pig iron production to 1,380,000 metric tons, an increase of 55 percent. The significance of this increase is especially pronounced when it is recalled that the Four-Year Plan adopted by Poland in 1937 for expansion of the iron and steel industry did not anticipate an annual production level of 1,300,000 metric tons before 1940.

The Trzyniec foundry operates 12 Martin furnaces for steel production, a Wellman-Seever tip-furnace, and a 300-ton mixer. It is estimated that Poland's production of raw steel for 1938, excluding the Trans-Olzan Silesia output, was about 1,525,000 metric tons, and it is probable that the output of present-day Poland for 1939 will reach 2,275,000 metric tons, an increase of 50 percent. As in the case of pig iron, this increase is the more significant as the Four-Year expansion plan adopted in 1937 provided for an annual production level of 2 million tons in 1940. In addition to pig iron and raw steel, the Trzyniec foundry specializes in rolling-mill products having an estimated annual capacity of 400,000 tons of semimanufactured commodities or 300,000 tons of finished manufactures as against a total annual Polish production of 1 million tons prior to annexation of this area. The bulk of semimanufactured products made at Trzyniec is forwarded for processing to a plant that belongs to the same corporation at Bogumin.

The other iron and steel center of Trans-Olzan Silesia is Bogumin, where the Alfred Hahn Co. established a foundry 50 years ago. The controlling interest in the company is said to be held by the Rothschild interests. This foundry employes over 1,000 workmen and operates a large blast furance and four Martin furnaces with an annual capacity of 150,000 metric tons of raw steel. It also operates an extensive pipe plant, whose capacity—900,000 tons annually—exceeds that of all Polish pipe factories.

HUNGARY

Czech contribution to mineral wealth of Hungary.—A new Hungarian-Czech frontier was defined on November 2, 1938. The area then lost by Czechoslovakia—about 4,200 square miles along the southern border of Slovakia and Ruthenia (Carpatho-Ukraine)—is considered less important as a source of mineral raw materials than territories acquired by Germany and Poland. After the World War Czechoslovakia acquired from Hungary iron mines that produced about 725,000 metric tons of ore annually; Hungary's acquisition in November 1938 of Czech territory involves the return to Hungary of mines producing approximately 234,000 metric tons of iron ore annually. Production from these mines ~~has~~ for years been discouraged by the Czech authorities, and it appears certain that output can be increased considerably.

Hungary regained the lignite or brown-coal basins in the former frontier, where it is reported production was allowed to decline when the territory was part of the Czech Republic. As Hungary already had ample reserves of lignite but imported large tonnages of bituminous coal and anthracite, the increase in lignite resources has little importance. Hungary also regained the magnesite deposits of former Czechoslovakia, but the annual output in recent years has been less than 10,000 tons of crude magnesite; therefore, this gain is relatively unimportant. Certain basalt quarries, antimony mines, and kaolin and soapstone deposits, which were in operation but had an output of slight commercial importance, were also regained by Hungary.

Acquisition of the former Czech Province of Ruthenia (Carpatho-Ukraine) in March 1939 adds little to the mineral resources of Hungary. The industrial gains by Hungary through acquisition of former Czech territory are not great. In these areas the former Czechoslovak Government encouraged agriculture but discouraged industrial development, except for minor industries connected with the processing of agricultural products. Before the World War the iron and metal industries in this area employed 15,000 workers, but this number was reduced to 3,000 by 1930. Most other industries experienced the same reduction in employment, and many industrial plants were closed by the Czech authorities.

ITALY

General statement relative to conditions during 1938.—Italy's known mineral resources make it virtually impossible for that nation to become self-sufficient, regardless of Government expenditures on mine development work, subsidies to producers whose production costs exceed world market prices, and forced substitution of domestic products for essential imports. During 1938 intensive efforts were made to increase the domestic output of coal, oil, iron ore, copper, and certain other metals, but comparatively little progress was made in this direction. With the exception of bauxite, aluminum, mercury, sulfur, and zinc Italy depends on foreign sources for a large percentage of its mineral requirements.

According to statements in the Italian press during 1938, the country is expected to become independent of coal, oil, and iron ore imports. Toward the end of 1938, the Government erected in Rome an impressive and educational exhibit—"Mostra autarchica del minerale italiana"—of the country's mineral and metal industries, said to have cost $5,000,000. All minerals on display may be found in Italy but not in sufficient tonnages of commercial grades to warrant development or to justify the conclusion that Italy is or can become self-sufficient with regard to domestic resources.

By the end of 1938, Italy was producing 1 percent of the crude oil, 5 percent of the copper, 15 percent of the coal, 25 percent of the iron, 45 percent of the manganese, and 70 percent of the lead consumed in Italy. There is practically no domestic output of nickel, chrome, tungsten, or tin. On the other hand, there is a surplus of mercury, sulfur, bauxite, aluminum, and zinc.

Financing the program leading toward mineral self-sufficiency.—National self-sufficiency or autarchy in the mineral industries has been a costly program for Italy, but the expressed purpose is a determination to lessen the dependence of Italy on foreign sources of supply in times of national emergency and to reduce unemployment to a minimum. To avoid depletion of its gold reserve, Italy is making strenuous efforts to increase exports of surplus mineral products and has applied restrictions on imports and uses of several mineral and metal products. The program of national self-sufficiency in minerals is administered by the Azienda Minerali e Metalli Italiana, and the latter's operating expense is borne in part by Italian banks that hold shares in the organization. On December 15, 1938, the Government announced that the program of national self-sufficiency should be effected from national savings through institutions equipped for long- and medium-term operations, principally through the Instituto Mobiliare Italiano. Credit institutions are to allocate a suitable portion of their funds for the purchase of obligations for this purpose and must assist in marketing these obligations among the Italian public. Public and private insurance organizations likewise must cooperate.

As many of the projects for increased mineral production are considered noncommercial, public funds can be obtained only through such a system of forced subscriptions from private savings.

Italy is by far the poorest of the so-called "Great Powers" of Europe in regard to natural resources; nevertheless, the Government is strenuously applying plans for self-sufficiency through stimulated domestic output and increased imports only of essential raw materials which are, in many instances, being stored for emergency use. Throughout 1938 all heavy industries operated at capacity.

Iron and steel industry.—The output of Italian iron ore represents about one-fourth of the requirements for the steel industry. Another 10 percent of the iron ore required is derived by treatment of pyrite ash in electric furnaces. The remainder of the iron consumed is obtained largely through imports of scrap iron and from domestic scrap.

Application of sanctions by the League of Nations late in 1935 stimulated domestic production of iron ore to replace imports of scrap iron, which in 1935 totaled about 1,000,000 metric tons and in 1937 and 1938 averaged 550,000 tons. Early in 1938 the Government approved the reorganization of the Italian iron and steel industry along such lines as would insure the maximum degree of self-sufficiency as quickly as possible. Efforts are to be made to double the iron ore output by 1940 by increasing annual production of the Elba mines to 600,000 tons, at Cogne in Val d'Aosta to 350,000 tons, the Val d'Aspra mines from 50,000 to 100,000 tons, and the mines of Bergomastre from 50,000 to 100,000 tons; and increase to 250,000 tons a year of the Nurra iron ore deposits in northern Sardinia was also provided for. With these increases, together with the output of the smaller mines and greater use of pyrite ash, it may be possible to supply nearly one-half of Italy's iron requirements from domestic sources by 1940.

The increase in iron ore production during 1938 was less than anticipated, and imports were more than doubled to meet the requirements of the steel industry. Morocco supplied 216,212 tons, Algeria 33,676 tons, and Turkey 33,048 tons. In January 1939 a contract was made with the Franco Government of Spain for 45,000 tons of ore from Bilbao to be delivered by June 1939.

Manganese ore production in 1939 is expected to reach 50,000 tons. Imports in 1937 were 75,384 and 1938, 58,079 tons.

Pig iron output in 1938 increased about 10 percent, but imports of pig iron advanced from 22,185 tons in 1937 to 68,731 in 1938, with Spain supplying 45,504 tons in 1938 compared with only 700 in 1937.

In 1938 authorization was granted to the Societa Italiana Acciaierio Cornigliano, an affiliate of the Ansaldo Co., to erect a new steel plant at Genoa. When this is completed the bulk of the Italian iron and steel industry will be concentrated in three great establishments at Bagnoli, Piombino, and Genoa.

Imports of scrap iron during 1938 were 615,339 tons (the United States supplying 406,867 tons) compared with 545,053 in 1937. A total of 55,235 tons of scrap iron and steel was obtained domestically by demolishing old ships, most of which, however, were purchased abroad. A semi-Government institution is authorized by Royal Decree of June 1938 to purchase and distribute iron and steel scrap required by iron and steel producers. This organization maintains headquarters in Rome, and its capital is made up of contributions by the manufacturers in proportion to the raw steel and iron produced by them during the period July 1, 1936, to June 30, 1937. Imports of pig iron are controlled by the National Consortium for Raw Materials for Iron Foundries of Milan. The sale, distribution, and prices of iron and steel products within Italy are controlled by the new Italian Iron and Steel Union of Milan.

Nonferrous metal industries.—Among the nonferrous ores and metals, lead was outstanding in 1938, with a 10-percent increase in production of both ore and metal. Lead imports during the year totaled 8,609 metric tons compared with 10,887 tons in 1937. Germany and Mexico were the principal countries of origin. The Montevecchio mine and the lead smelter at San Gavino in Sardinia contributed most in the increase of production.

The 12-percent increase in the production of zinc ore in 1938 was due chiefly to Government subsidy to mining companies. The lead-zinc mines in Sardinia and at Raibl in northern Italy contributed to this increase. Zinc ore exports increased about 5,000 tons in 1938. Although the 1938 output of zinc metal represents a decrease of 10 percent below the 1937 figure, it is expected that the new electrolytic zinc plant at Porto Maghera will provide a decided increase in 1939. Exports of slab zinc in 1937 amounted to 400 tons, but in 1938, 450 tons of the metal were imported. A decree of April 28, 1938, provides for a premium of 1.25 lire for each ton of zinc concentrate exported after January 1, 1938, and for each pound-sterling difference between London quotations for zinc and £19. For each ton of zinc concentrate exported, over and above the 1937 export figure, 1.25 lire per ton also is paid for each pound-sterling difference between London quotations and £23, provided the production of lead ore has increased over that of 1937, which increase must not be less than 10 percent in 1938, 20 percent in 1939, and 30 percent in 1940. These premiums are intended to stimulate the output of lead, not zinc, as there is a surplus of the latter, but because the complex ores run high in zinc, metallic lead production has not been adequate to meet domestic requirements. Both the imports and exports of lead and zinc are subject to license and are controlled by the National Metal Office, Milan. The exportation of zinc and lead is prohibited, except under license, by decree dated December 7, 1937.

Bauxite production increased slightly in 1938, and because of greater domestic consumption exports dropped 55,000 metric tons compared with those in 1937. Of importance in 1938 was the opening of new bauxite deposits at Gargone in southeastern Italy by the Societa di Montecatini.

Aluminum output was increased to 26,000 metric tons in 1938, and an even greater increase is anticipated for 1939, as the alumina and aluminum plants at Porto Maghera, Mori, and Bolzano are being enlarged. At Aurelia, near Civitavecchia, where unsuccessful attempts were made to produce alumina from lucite, the plant is being rebuilt to produce alumina from bauxite and the product will be shipped to the aluminum plant at Borgo Franco in northern Italy. Foreign trade in bauxite and aluminum are subject to license. The domestic market for aluminum is controlled by the S/A Alluminio of Milan.

The output of mercury ore in 1938 increased but production of metallic mercury decreased compared with 1937. The world market for Italian mercury was favorable throughout 1937, when export amounted to 2,172 metric tons, but in 1938 exports dropped to 1,575 tons. The decrease in 1938 was due to reduced purchases by Great Britain and the United States.

Among the nonferrous metals, the lack of an adequate domestic supply of copper is Italy's greatest handicap. Present production is derived from domestic and imported cupriferous pyrite ore. Imports of cupriferous pyrites from Spain during 1938 of 5,000 tons represents a noticeable increase from the 1,000 tons imported in 1937. Metallic copper imported in 1938 amounted to 77,333 tons, a slight increase compared with the imports during 1937.

Nickel is another metal the domestic supply of which is wholly inadequate to meet Italy's requirements. Considerable exploratory work is being conducted in the Piedmont region, where pyrrhotite veins and masses containing some nickel have been located, and in Sardinia, where extensive quartz veins containing nickel have been developed and a small output reported. Metallic nickel imports of 3,694 tons in 1938 represent an increase above the 2,822 tons imported during 1937, and it is reported that a portion of the imported raw material has been stored for future use.

Although Italy has no commercial source of tin, efforts are being made, at great expense, to develop deposits in the Arbus area, Sardinia, and at Mount Valerio in Tuscany. Metallic tin production of Italy increased from 80 metric tons in 1937 to 320 tons in 1938, but part of this is reported to be metal recovered from scrap. Metallic tin imports increased from 3,639 tons in 1937 to 4,441 tons in 1938, and, as with nickel, it is reported that a considerable portion of the metal has been stored for future use.

During the past few years in the interest of conservation, the Italian Government has regulated imports and domestic consumption of certain mineral and metal products. This policy continued throughout 1938. A royal decree dated June 16, 1938, prohibits (under certain conditions set forth in appropriate regulations) the use of copper, nickel, tin, chrome, cobalt, and their alloys in the manufacture of industrial products wherever substitutes of domestic origin may be utilized. The Government also may prohibit importation of manufactured products made of copper, nickel, tin, chrome, cobalt, and their alloys. The Italian Official Gazette of December 12, 1938, published another decree dated November 28, 1938, which limits the use of copper and its alloys in the manufacture of electric conductors and cables. This decree probably is intended to stimulate the use of aluminum of domestic origin.

Other minerals.—Production of crude sulfur in Italy during 1938 increased 33,000 metric tons compared with the preceding year, but exports dropped sharply in 1938. A slight increase in exports of refined sulfur occurred in 1938. Sulfur stocks at the disposal of the Italian Sales Office were greatly increased during 1938. The greatest difficulties faced by the Italian sulfur producers were the increasing competition originating outside of the American-Italian combination and the added competition from Spanish pyrite producers who are shipping increased tonnages of sulfur to Great Britain and France. It is anticipated that sulfur production from coke gas in Germany eventually will reduce imports by that country from Italy. The future outlook for the Italian sulfur industry is not particularly encouraging. All sulfur exports are controlled by the Ital-Zolfi organization in Rome.

There was little change in the statistical position of the Italian pyrite industry during 1938. The estimated output during the year was 926,000 tons, most of which originates from the mines in Tuscany. The net exports during 1938 showed a reduction to 131,912 tons from 271,308 tons in 1937. Pyrite imports are permitted only by license from Istcambi.

The principal coal mines in Italy gradually have been absorbed by the Azienda Carboni Italiana, a Government organization that administers mine development work, production, and marketing. Large expenditures were made in 1938 by this organization on development work in the Sulcis coal field of Sardinia and in the Arsa coal field on the Pola Peninsula. Most of the mines have been mechanized and modern washeries built, and it is planned to double the output of these two coal fields by 1940. In 1938 the output of the Arsa field was 866,000 tons and that of the Sulcis field 550,000 tons. In addition to production in these two fields, the anthracite output from the La Thuile mines in Val d'Aosta and the lignite mines near Valdarno in Tuscany must be considered.

Coal imports in 1938 were 11,816,995 tons compared with 12,572,816 tons during 1937. Germany is the principal supplier, and Great Britain and Poland follow in the order named. Assuming that it takes 1⅓ tons of Italian coal to equal 1 ton of imported coal, Italy's domestic production may be estimated to represent about 13 percent of her apparent consumption. Unless the present rate of consumption is materially reduced by increased use of hydroelectric power by railways and industrial plants, it will be some years before Italy can supply from domestic sources the planned 20 percent of her coal requirements. Italy is without domestic sources of coking coal and depends principally on Germany for her requirements of coking coal and coke.

Imports of both coal and coke are controlled by the Italian State Railway Administration in Rome, commonly known as a Government monopoly which acts as the buying agent for importers and serves as distributing agent for domestic dealers and consumers. Dealers and consumers are allotted quotas based on their imports in 1934.

Production of natural crude oil in Italy during 1938 amounted to 13,200 metric tons, or less than 1 percent of the tonnage imported during the year. From the Davoli oil fields in Albania the output for 1938 was estimated at 90,000 tons, two-thirds of which was imported by Italy.

The refinery capacity in Italy nearly suffices to produce most of the output required. With the new refineries of the Azienda Nazionale Idrogenazione Combustibile in operation at Bari and Leghorn, where hydrogenation as well as the cracking process will be applied, an additional 240,000 tons of gasoline may be recovered during 1939. However, instead of obtaining the 300,000 tons of crude oil required by these plants from Albania, about 200,000 tons of this quantity will of necessity have to be imported from elsewhere.

Italian gasoline consumption in 1938 is estimated at 440,000 tons, of which 406,000 tons were furnished by Italian refineries.

The total imports of petroleum products for 1938 is estimated at about 2,500,000 tons. Of Italy's total oil imports, 70 percent enters the Mediterranian via Gibraltar.

All imports of petroleum products are controlled and quotas allotted to importing firms by the Ufficio Speziale per Combustibile Liquidi, an agency that operates under the Ministry of Corporations.

This office also regulates the retail price, which at the end of 1938 was about 70 cents a gallon for gasoline.

The A. G. I. P., a Government-financed petroleum company, continued throughout 1938 exploratory drilling for oil at several points along the Po Valley and on the Great Dalac Island in the Red Sea; geological studies were also extended throughout Ethiopia and in Libia near the Egyptian frontier. There were no discoveries of importance, but the existing oil structures are reported to be favorable to oil possibilities.

On November 9, 1938, the Council of Ministers approved a second Five-Year Plan for oil exploratory work in Italy and its colonies, to be financed by the Government and carried out under the auspices of the A. G. I. P. Late in 1938 negotiations were being conducted between Italy and Mexico leading toward a barter arrangement involving the exchange of Mexican crude oil for merchant tonnage to be built in Italian shipyards.

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PART II. METALS

GOLD AND SILVER

By Chas. W. Henderson and J. P. Dunlop

SUMMARY OUTLINE

Mine production of gold in the United States (Territories included) set a new annual record in 1938, surpassing the former record made in 1915 by 352,336 ounces in quantity and $81,370,691 in value. In the 5 years (1934–38) that have passed since gold was revalued at $35 per fine ounce in terms of United States currency (compared with $20.67+ from 1837 to 1933) the domestic annual output has nearly doubled. Although final figures on the total production of gold in the world in 1938 are not yet available, preliminary data indicate that the world output also was the highest on record, having increased 49 percent since 1933. The principal gold-producing countries in 1938, in order, were the Union of South Africa, U. S. S. R., Canada, and continental United States; these four countries together produced approximately 71 percent of the total world output of gold. Silver production in the United States decreased from 72,128,397 fine ounces in 1937 to 62,873,450 in 1938. The output in 1932, the year before legislation was enacted to raise the price, was only 22,899,865 ounces. Approximately 70 percent of the total world output of silver in 1938 came from four countries—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 totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by means of information collected by the Bureau of Mines directly from the producing mines and 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, 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, 1934–38, and approximate distribution, by States and Territories, in 1937 and 1938

[Figures supplied by U. S. Bureau of the Mint]

State or Territory	Gold[1]		Silver[2]	
	Fine ounces	Value	Fine ounces	Value
1934	3, 091, 183	$108, 191, 400	32, 725, 353	$21, 155, 784
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:				
Alabama	2, 483	86, 900	734	568
Alaska	628, 800	22, 008, 000	656, 894	508, 108
Arizona	344, 060	12, 042, 100	9, 541, 141	7, 380, 073
California	1, 169, 491	40, 932, 200	2, 794, 550	2, 161, 584
Colorado	379, 246	13, 273, 600	6, 286, 393	4, 862, 525
Georgia	563	19, 700	44	34
Idaho	82, 811	2, 898, 400	19, 556, 118	15, 126, 657
Illinois			1, 236	956
Maryland	1, 070	37, 400	30	23
Michigan	51	1, 800	19, 022	14, 714
Missouri			118, 080	91, 335
Montana	204, 903	7, 171, 600	11, 740, 970	9, 081, 640
Nevada	272, 531	9, 538, 600	4, 722, 623	3, 652, 949
New Mexico	43, 354	1, 517, 400	1, 400, 330	1, 083, 155
New York			45, 752	35, 389
North Carolina	871	30, 500	5, 649	4, 370
Oregon	53, 757	1, 881, 500	75, 154	58, 132
Pennsylvania	1, 423	49, 800	10, 206	7, 894
Philippine Islands	692, 363	24, 232, 700	642, 864	497, 255
Puerto Rico	17	600	1	1
South Carolina	1, 957	68, 500	491	380
South Dakota	575, 814	20, 153, 500	142, 063	109, 886
Tennessee	663	23, 200	50, 065	38, 724
Texas	566	19, 800	1, 338, 393	1, 035, 247
Utah	311, 943	10, 918, 000	12, 692, 203	9, 817, 419
Virginia	1, 149	40, 200	787	609
Washington	32, 974	1, 154, 100	99, 627	77, 062
Wyoming	1, 680	58, 800	374	289
	4, 804, 540	168, 158, 900	71, 941, 794	55, 646, 978
1938:				
Alabama	37	1, 300	3	2
Alaska	659, 831	23, 094, 100	563, 806	364, 481
Arizona	307, 646	10, 767, 600	7, 483, 213	4, 837, 633
California	1, 317, 549	46, 114, 200	2, 694, 270	1, 741, 750
Colorado	375, 317	13, 136, 100	7, 805, 543	5, 046, 008
Georgia	780	27, 300	63	41
Idaho	98, 003	3, 430, 100	18, 397, 204	11, 893, 142
Illinois			92	59
Maryland	857	30, 000	24	15
Michigan			106, 468	68, 828
Missouri			169, 223	109, 397
Montana	188, 360	6, 592, 600	6, 761, 582	4, 371, 124
Nevada	280, 009	9, 800, 300	4, 114, 601	2, 659, 944
New Mexico	41, 800	1, 463, 000	1, 261, 996	815, 836
New York			40, 834	26, 398
North Carolina	1, 977	69, 200	4, 985	3, 223
Oregon	80, 397	2, 813, 900	91, 761	59, 320
Pennsylvania	1, 406	49, 200	10, 625	6, 869
Philippine Islands	844, 434	29, 555, 200	976, 501	631, 273
Puerto Rico	9	300	1	1
South Carolina	11, 414	399, 500	2, 444	1, 580
South Dakota	591, 757	20, 711, 500	158, 164	102, 247
Tennessee	380	13, 300	38, 918	25, 159
Texas	431	15, 100	1, 381, 110	892, 839
Utah	215, 414	7, 539, 500	10, 288, 613	6, 651, 224
Virginia	3, 040	106, 400	1, 484	959
Washington	68, 103	2, 383, 600	311, 345	201, 273
Wyoming	860	30, 100	462	299
	5, 089, 811	178, 143, 400	62, 665, 335	40, 510, 924

[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+.

The quantity of gold reclaimed in 1937 from old jewelry, dental waste, scrap, and other material received at private refineries and the United States mints and assay offices was 1,040,227 ounces and that sold for industrial use 1,132,067 ounces, the difference (91,840 ounces) representing the quantity of new gold absorbed by 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. Secondary silver recovered in 1937 from silverware, photographic film, and other sources totaled 23,564,986 ounces and that issued for use in the industrial arts 51,292,270 ounces, indicating that 27,727,284 ounces of new silver were required for industrial use.

Gold and silver produced in the United States, 1792–1937

[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
1873–1937	185,277,723	4,057,307,600	3,340,725,083	2,529,688,502
	244,744,671	5,286,594,600	3,459,602,783	2,687,842,902

[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 at $0.64+ per fine ounce, in 1935 at $0.71875, in 1936 at $0.7745, and in 1937 at $0.7735.

The average commercial value per fine ounce of silver for the total recorded domestic production is $0.777.

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 1938. 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 of $0.7757+ for newly mined silver was maintained throughout 1936 and 1937, but was reduced by Presidential proclamation on December 31, 1937 to $0.64646464+ and continued at that price through 1938. The annual average prices[2] used for domestic silver from 1932 to 1938 are as follows: 1932,

[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.

$0.282; 1933, $0.350; 1934, $0.64646464; 1935, $0.71875; 1936, $0.7745; 1937, $0.7735; 1938, $0.64646464.

The following table, copied from the Annual Report of the Director of the Mint for the Fiscal Year Ended June 30, 1938, shows the price of silver in London and in New York in 1937 and the first half of 1938.

Price of silver in London and in New York, 1937–38

[From the Report of the Director of the Mint]

Month	London price per ounce, 0.925 fine [1]			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			
	Pence	*Pence*	*Pence*	*Dollars*	*Dollar*	*Dollar*
1937						
January	21 5/16	20 1/4	20.7344	4.9075	0.45835	0.45224
February	20 3/16	19 15/16	20.0833	4.8939	.44277	.45062
March	21 1/8	20 3/16	20.6771	4.8851	.45499	.45442
April	21 1/2	20 3/16	20.7404	4.9163	.45930	.45772
May	20 7/16	20 1/4	20.3463	4.9399	.45280	.45337
June	20 3/8	19 3/4	20.0216	4.9355	.44512	.45130
July	20 3/16	19 13/16	19.9861	4.9672	.44728	.45062
August	20	19 3/16	19.8475	4.9822	.44543	.45062
September	20	19 3/4	19.8894	4.9530	.44382	.45062
October	20 1/16	19 13/16	19.9423	4.9551	.44512	.45062
November	19 15/16	19 9/16	19.7067	4.9961	.44319	.45062
December	19 11/16	18 3/16	18.8350	4.9964	.42428	.45062
1938						
January	20 3/8	19 1/4	19.8950	4.9998	.44807	.45062
February	20 3/8	19 15/16	20.1588	5.0180	.45567	.45062
March	20 9/16	18 3/8	20.0880	4.9845	.45103	.44758
April	19 1/8	19 9/16	18.8804	4.9812	.42338	.43062
May	18 15/16	18 5/8	18.7307	4.9673	.41898	.43062
June	19 1/16	18 11/16	18.9450	4.9580	.42315	.43062
Average, calendar year 1937			20.0675	4.9440	.44687	.45195
Average, fiscal year 1937–38			19.5751	4.9799	.43912	.44537

[1] London price in depreciated currency after Sept. 21, 1931.

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, 1939, and of the gold reserves of central banks and governments as of March 31, 1939.

Daily statement of current assets and liabilities of the United States Treasury, June 1, 1939

GOLD

Assets		Liabilities		
Gold (oz. 455,943,570.6)	$15,958,024,969.47	Gold certificates:		
		Outstanding (outside of Treasury)		$2,887,935,069.00
		Gold certificate fund—Board of Governors, Federal Reserve System		10,506,275,119.95
		Redemption fund—Federal Reserve notes		9,545,844.33
		Gold reserve		156,039,430.93
		NOTE.—Reserve against $346,681,016 of United States notes and $1,166,822 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
				15,359,795,464.21
		Gold in general fund:		
		Balance of increment resulting from reduction in the weight of the gold dollar	$142,351,032.26	
		In working balance	455,878,473.00	
				598,229,505.26
Total	15,958,024,969.47	Total		15,958,024,969.47

SILVER

Silver (oz. 938,480,993.5)	$1,213,389,567.46	Silver certificates outstanding	$1,654,322,701.00
Silver dollars (oz. 388,642,059.3)	502,486,703.00	Treasury notes of 1890 outstanding	1,166,822.00
		Silver in general fund	60,386,747.46
Total	1,715,876,270.46	Total	1,715,876,270.46

Gold reserves of central banks and governments as of Mar. 31, 1939 [1]

Country	Millions of dollars	Country	Millions of dollars
United States	15,258	Europe—Continued.	
Canada	210	Spain	525
		Sweden	332
Europe:		Other countries	719
United Kingdom [2]	1,066		
France	2,435	Total (26 countries) [4]	7,379
Germany	29	Latin America (11 countries)	656
Italy	193	Asia and Oceania (8 countries)	595
Belgium	518	Africa (5 countries)	299
Netherlands	909		
Switzerland [3]	653	Total (52 countries) [4]	24,397

[1] Data from Federal Reserve Board.
[2] In addition, the British Exchange Equalization Account held $759,000,000 in gold, and an additional $1,648,000,000 transferred on Jan. 6, 1939, from Bank of England to Exchange Equalization Account for which next official report, that for March 31, will not be available until June 30.
[3] National Bank $640,000,000; B. I. S. $13,000,000.
[4] Stabilization funds in some countries not reported. Preliminary figure of Federal Reserve Board for total reserves of the 52 countries is $25,130,000,000.

IMPORTS AND EXPORTS [3]

Value of gold and silver imported into and exported from the United States, 1937–38, by classes

	Imports	Exports	Excess of imports over exports
1937			
Gold:			
Contained in ore and base bullion	$74,214,974	$933,764	$73,281,210
Bullion refined	1,554,666,687	45,086,254	1,509,580,433
United States coin	1,965		1,965
Foreign coin	2,639,644		2,639,644
	1,631,523,270	46,020,018	1,585,503,252
Silver:			
Contained in ore and base bullion	21,540,648	616,435	20,924,213
Bullion refined	48,320,445	952,435	47,368,010
United States coin	278,422	9,582	268,840
Foreign coin	21,737,469	10,463,887	11,273,582
	91,876,984	12,042,339	79,834,645
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

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, and 90 percent in 1938. 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, and 8 percent in 1938. These sources accounted for 96 to 98 percent of the gold supply in 1915 and 1930–38.

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 1937 dry and siliceous ores yielded 45 percent and in 1938, 52 percent; copper ore, 29 percent and 26 percent; lead ore, 7 percent and 5 percent; and zinc-lead ore, 19 percent and 17 percent. The rounded percentage figures for both 1937 and 1938 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 1937 is 1,256,992,826 fine ounces of gold valued at $27,774,074,919 and 16,446,205,815 fine ounces of silver valued at $15,137,077,346.

The following tables show the world output of gold and silver from 1934 to 1938.

World production of gold, 1934–38, by countries, in fine ounces [1]

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
North America:					
United States:					
Continental	2,741,660	3,163,103	3,759,162	4,804,523	[2] 4,245,367
Puerto Rico	46	63	483	17	9
Canada	2,972,074	3,284,890	3,748,028	4,096,213	4,715,480
Central America and West Indies:					
Costa Rica	10,315	10,311	32,500	13,164	[3] 17,500
Cuba	(4)	(4)	[3] 2,140	12,200	4,700
Dominican Republic (exports)	5,312	7,553	8,901	7,102	5,275
Guatemala	7,500	4,221	1,824	4,180	5,466
Honduras	14,342	13,286	15,176	39,584	32,600
Nicaragua	19,424	16,193	23,077	24,242	44,301
Panama	15,604	5,705	9,189	14,000	[3] 4,900
Salvador	6,824	8,129	8,928	8,564	14,566
Other countries [3]	43,700	52,400	33,300	17,000	10,700
Mexico	607,649	682,335	753,967	846,381	923,819
Newfoundland	11,219	12,728	16,114	22,470	24,104
	6,463,000	7,278,000	8,413,000	9,910,000	10,049,000
South America:					
Argentina	1,200	9,902	12,217	10,449	(4)
Bolivia	[5] 11,600	[5] 19,850	32,151	37,092	(4)
Brazil	141,729	120,597	125,405	145,771	142,899
Chile	237,658	265,944	248,799	272,704	294,001
Colombia	344,140	328,999	389,495	442,222	520,715
Ecuador	66,427	71,512	78,685	59,500	74,042
Guiana:					
British	25,420	30,488	32,234	35,993	39,726
Dutch (Surinam)	11,896	11,349	14,258	12,756	14,154
French	45,525	47,390	45,546	47,101	40,637
Peru	98,853	110,962	152,409	168,669	254,473
Uruguay	----	----	----	----	657
Venezuela	109,055	112,390	109,996	116,519	112,085
	1,093,503	1,129,383	1,241,195	1,348,776	1,545,000
Europe:					
Czechoslovakia	7,588	16,575	16,248	9,930	10,000
Finland	----	4,630	4,919	4,822	3,858
France	101,500	91,598	85,682	66,423	70,700
Germany	5,755	5,958	7,584	8,028	(4)
Austria	----	----	----	140	(4)
Hungary	1,833	1,479	836	5,159	5,655
Italy	2,476	2,894	3,697	3,103	(4)
Norway	129	231	42	96	(4)
Portugal	27	----	3,282	3,982	6,186
Rumania	120,040	143,424	150,755	166,540	172,453
Spain	7,588	4,823	4,019	(4)	(4)
Sweden	246,693	180,559	158,342	193,226	197,984
Switzerland	----	804	965	964	1,125
U. S. S. R. [3]	3,633,000	4,547,000	5,327,000	5,359,000	5,236,000
United Kingdom	51	148	1	60	2,400
Yugoslavia	71,342	74,172	84,106	87,578	78,301
	4,198,000	5,074,000	5,847,000	5,912,000	5,799,000

See footnotes at end of table.

World production of gold, 1934–38, by countries, in fine ounces—Continued

Country	1934	1935	1936	1937	1938
Asia:					
Burma	900	1,483	1,439	1,004	1,063
China	154,966	(4)	(4)	(4)	(4)
Chosen	417,960	472,948	562,316	734,585	[3] 730,000
Cyprus (exports)	13,092	6,872	20,991	23,650	30,366
India, British	321,253	326,170	331,946	330,744	321,334
Indochina	6,880	9,774	9,025	9,870	(4)
Japan	486,987	588,161	713,685	723,375	[3] 760,000
Malay States:					
Federated	30,221	29,771	37,779	33,828	40,209
Unfederated	1,197	276	761	519	546
Netherland India	71,866	68,256	71,664	55,621	76,422
Philippine Islands	340,316	451,814	597,266	716,967	903,265
Sarawak	28,842	28,549	23,372	19,214	18,520
Siam	(4)	10,337	10,353	11,045	9,016
Taiwan	33,636	37,217	41,608	[3] 50,000	(4)
Turkey	----------	----------	----------	----------	514
	1,918,000	2,197,000	2,607,000	2,825,000	3,035,000
Africa:					
Bechuanaland	9,486	11,419	16,746	17,577	19,111
Belgian Congo	329,449	370,409	389,281	431,688	[3] 460,000
Cameroons, French	418	2,829	11,027	14,225	15,540
Egypt	201	58	278	1,226	2,129
Eritrea	8,040	4,286	1,608	(4)	(4)
Ethiopia	[3] 10,000	13,736	25,700	(4)	(4)
French Equatorial Africa	28,839	27,971	22,088	21,490	40,028
French West Africa (exports)	97,706	125,677	114,424	128,217	127,220
Gold Coast	326,040	358,835	428,144	559,212	674,927
Kenya Colony	12,110	23,009	38,463	54,774	69,436
Liberia	----------	965	[6] 1,567	2,457	[6] 1,902
Madagascar	15,979	15,465	15,111	13,471	[6] 12,699
Morocco, French	----------	780	1,500	4,630	(4)
Nigeria	37,023	38,962	33,364	26,466	24,815
Nyasaland	84	127	30	2	(4)
Portuguese East Africa	19,641	6,379	8,223	11,129	17,328
Rhodesia:					
Northern	2,113	1,647	4,452	4,228	1,113
Southern	691,152	726,281	797,061	804,219	814,078
Sierra Leone	21,205	30,753	37,966	35,717	30,457
South-West Africa	908	3,206	4,065	2,804	(4)
Sudan	5,398	8,550	7,659	7,388	8,866
Swaziland	379	314	276	2,410	9,035
Tanganyika	42,606	52,182	69,675	75,281	86,162
Uganda	5,842	5,651	13,231	16,947	20,502
Union of South Africa	10,479,857	10,773,991	11,336,214	11,734,575	12,161,392
	12,144,000	12,603,000	13,378,000	14,002,000	14,636,000
Oceania:					
Australia:					
New South Wales	36,123	50,102	60,739	68,607	88,698
Northern Territory	2,147	9,272	7,705	11,563	12,378
Queensland	115,471	102,990	121,174	127,281	151,432
South Australia	6,870	7,333	7,681	6,962	5,292
Victoria	70,196	87,609	113,940	145,799	144,243
Western Australia	639,871	646,150	852,422	1,000,647	1,167,791
Fiji	931	6,728	16,955	24,917	92,362
New Guinea	184,505	184,009	220,974	217,152	236,133
New Zealand	160,248	165,277	164,575	168,487	[6] 151,162
Papua	12,591	17,012	20,719	22,153	27,000
Tasmania	5,622	8,343	17,600	20,276	22,200
	1,234,575	1,284,825	1,604,484	1,813,844	2,098,691
	27,050,000	29,565,000	33,090,000	35,810,000	37,165,000

[1] Prepared with the cooperation of the Office of the Director of the Mint. All figures for 1938 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] Approximate production.
[4] Data not available. Estimate included in total.
[5] Purchases by the Central Bank of Bolivia.
[6] Exports.

World production of silver, 1934–38, by countries, in fine ounces [1]

Country	1934	1935	1936	1937	1938 (preliminary)
North America:					
United States [2]	32,486,879	45,612,918	63,350,587	71,298,929	61,688,834
Canada	16,415,282	16,618,558	18,334,487	22,977,751	22,157,154
Central America and West Indies:					
Honduras	3,091,522	2,641,346	3,104,507	3,211,296	3,335,070
Other countries [3]	408,000	859,000	495,000	390,000	365,000
Mexico	74,145,012	75,589,199	77,463,901	84,680,875	81,018,809
Newfoundland	1,103,091	1,123,997	1,249,472	1,447,637	1,668,622
	127,650,000	142,445,000	163,998,000	184,006,000	170,233,000
South America:					
Argentina	60,000	49,994	512,322	2,121,000	3,755,000
Bolivia	5,216,297	7,951,000	10,723,333	9,454,000	6,386,000
Brazil [4]	22,275	20,833	23,887	25,238	25,585
Chile	1,051,140	1,298,755	1,498,163	1,789,768	1,414,118
Colombia	127,461	132,965	151,501	167,971	192,880
Ecuador	110,815	80,658	96,310	98,500	89,100
Guiana, British	3,340	4,010	4,240	4,740	([5])
Peru	10,366,929	17,104,300	19,915,101	16,993,732	20,424,466
	16,958,000	26,643,000	32,925,000	30,655,000	32,292,000
Europe:					
Czechoslovakia	971,370	1,329,734	1,088,718	1,103,444	[3] 1,190,000
Finland	([5])	([5])	([5])	57,900	57,900
France	303,985	569,615	473,323	563,860	[3] 565,000
Germany	5,944,029	6,257,788	6,541,551	6,774,000	([5])
Austria	14,017	11,863	29,061	9,774	([5])
Greece [4] [6]	525,791	217,906	526,623	370,000	([5])
Hungary	9,163	4,983	3,794	50,965	46,631
Italy	373,217	453,283	616,000	715,000	780,000
Norway	200,103	266,851	228,270	282,904	241,000
Poland	21,155	32,311	60,507	64,237	62,244
Portugal	----------	----------	12,905	178	16,742
Rumania	417,670	471,876	594,757	670,214	819,816
Spain	1,788,289	861,640	[6] 900,000	[6] 600,000	[6] 500,000
Sweden	754,514	835,791	939,541	946,261	1,040,000
U. S. S. R. [3]	3,665,000	4,850,000	6,590,000	7,230,000	8,040,000
United Kingdom	138,955	92,851	76,872	71,439	108,000
Yugoslavia	1,748,000	1,753,534	1,785,620	2,242,546	2,524,074
	16,920,000	18,061,000	20,518,000	21,753,000	23,121,000
Asia:					
Burma	5,792,019	5,825,913	5,952,000	6,180,000	5,920,000
China [4]	147,594	150,000	150,000	201,000	([5])
Chosen	1,005,906	1,264,986	1,891,137	2,672,978	([5])
Cyprus (exports)	128,264	44,536	125,704	132,968	200,018
Hong Kong	----------	----------	----------	----------	111,070
India, British	25,505	24,493	25,345	24,642	26,794
Indochina	3,601	3,633	5,594	3,537	2,411
Japan	6,882,156	8,230,751	9,765,572	9,902,000	[3] 10,100,000
Netherland India	771,361	701,722	662,654	500,105	579,292
Philippine Islands	212,613	322,022	491,701	719,771	1,166,612
Sarawak	----------	----------	----------	----------	1,660
Taiwan	9,547	10,584	12,936	([5])	([5])
Turkey [6]	250,000	200,000	300,000	380,000	305,000
	15,229,000	16,779,000	19,383,000	20,732,000	21,528,000
Africa:					
Algeria	1,929	46,522	45,236	72,177	90,000
Bechuanaland	957	1,758	1,378	1,499	1,127
Belgian Congo	3,399,362	3,793,980	2,781,521	2,962,337	3,119,000
Gold Coast [4]	11,000	12,000	14,000	19,000	([5])
Kenya Colony	1,969	3,744	5,721	7,549	10,340
Morocco, French	----------	2,733	88,254	72,178	([5])
Nigeria	81,000	139,200	153,000	102,120	([5])
Portuguese East Africa	763	725	1,337	1,474	1,808
Rhodesia:					
Northern	187	151	229,151	83,861	88,237
Southern	128,381	132,087	145,072	152,038	166,419
Sierra Leone	1,400	1,673	1,537	1,568	([5])
Tanganyika	4,876	6,134	9,254	11,696	16,620
Tunisia	22,023	17,008	44,979	174,638	86,000
Uganda	383	346	924	1,379	1,981
Union of South Africa	1,002,203	1,042,203	1,075,626	1,100,641	1,131,708
	4,656,000	5,200,000	4,597,000	4,764,000	4,907,000

See footnotes at end of table.

World production of silver, 1934–38, by countries, in fine ounces—Continued

Country	1934	1935	1936	1937	1938 (preliminary)
Oceania:					
Australia:					
New South Wales	8,207,520	9,091,946	8,557,803	9,780,499	[3] 9,500,000
Queensland	2,259,574	2,409,165	3,084,008	3,264,994	3,533,490
South Australia			1,560	955	503
Victoria	3,106	3,948	7,964	5,443	5,898
Western Australia	45,765	50,516	76,798	180,562	271,346
Fiji		634	1,185	3,463	12,380
New Guinea [4]	81,000	83,000	97,000	96,000	141,760
New Zealand	382,615	437,967	432,973	443,981	369,896
Tasmania	284,687	323,901	906,458	1,060,785	1,219,550
	11,264,267	12,401,077	13,165,749	14,836,682	15,055,000
	192,675,000	221,530,000	254,585,000	276,745,000	267,135,000

[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] Imperial Institute (London), Statistical Summary.
[5] Estimate included in total.
[6] American Bureau of Metal Statistics (New York), Annual Issue.

MINE REPORT

METHOD OF COLLECTING STATISTICS

The first table in this report presents the official refinery figures of the production of gold and silver in the United States from 1933 to 1937, as agreed upon by the Bureau of the Mint and the Bureau of Mines. With the comparatively unimportant exceptions of domestic gold and silver contained in ore and matte exported for reduction during the year, these figures record the production 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 plans 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 the figures for a period of years sufficiently long to compensate for overlap or lag should agree within allowable limits of error.

Gold and silver produced in the United States, 1905–37, in fine ounces, according to mint and mine returns

Year	Mint		Mine	
	Gold	Silver	Gold	Silver
1905–33	98,362,334	1,683,625,006	97,977,476	1,672,297,719
1934	3,091,183	32,725,353	3,119,159	32,995,017
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
	114,224,734	1,898,028,783	114,024,647	1,887,909,257

Compared with the mine reports the mint reports show a total excess of gold for the 33 years of 200,087 ounces (a difference of 0.18 percent) and a total excess of silver of 10,119,526 ounces (a difference of 0.54 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 on 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 25 largest gold producers in the United States (Philippine Islands and Puerto Rico excluded) in 1938, none of which produced less than 19,700 ounces, was 2,087,123 fine ounces (49 percent of the total) compared with 2,165,642 ounces (52.5 percent of the total) in 1937. Decreases in 1938 in the quantity of gold recovered by several large copper-producing companies caused most of the reduction in the proportion of the total gold produced by the 25 largest producers. Four of the companies, working placer mines with floating connected-bucket dredges, recovered 397,471 ounces of gold; the remainder of the output of the largest producers came from lode mines.

Largest producers of gold in the United States in 1938, 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	Golden Cycle Corporation [2]	Colorado	Cripple Creek, etc	Dry and siliceous ore.
4	Alaska Juneau Mining Co	Alaska	Juneau	Do.
5	Empire Star Mines Co., Ltd	California	Grass Valley-Nevada City.	Do.
6	Idaho Maryland Mines Corporation.	do	do	Do.
7	Phelps Dodge Corporation	Arizona	Ajo, Verde, Warren	Copper ore.
8	Utah Copper Co	Utah	West Mountain	Do.
9	Yuba Consolidated Gold Fields.	California	Callahan, Oroville, Snelling, Yuba River.	Dredging gravel.
10	Natomas Co	do	Folsom	Do.
11	Capital Dredging Co	do	do	Do.
12	Black Mammoth Consolidated Mining Co.	Nevada	Silver Peak	Gold ore.
13	Howe Sound Co	Washington	Chelan	Copper ore.
14	Lava Cap Gold Mining Corporation.	California	Grass Valley-Nevada City.	Dry and siliceous ore.
15	Central Eureka Mining Co	do	Mother Lode	Do.
16	United States Smelting, Refining & Mining Co.	Utah	West Mountain and Tintic.	Zinc-lead ore, lead ore, dry and siliceous ore.
17	The Mountain Copper Co., Ltd.	California	Iron Mountain-West Belt.	Dry and siliceous ore.
18	Consolidated Coppermines Corporation.	Nevada	Robinson	Copper ore.
19	United States Smelting, Refining & Mining Co. (Gold Road).	Arizona	San Francisco	Dry and siliceous ore.
20	Carson Hill Gold Mining Corporation.	California	Mother Lode	Do.
21	Bald Mountain Mining Co	South Dakota	Trojan	Do.
22	Getchell Mines, Inc	Nevada	Potosi	Do.
23	London Mines & Milling Co	Colorado	Mosquito	Do.
24	Golden Queen Mining Co	California	Mojave	Do.
25	Summitville Consolidated Mines, Inc.	Colorado	Summitville	Do.

[1] Philippine Islands excluded.
[2] Custom mill. Includes mainly ore from Cresson, Portland, Ajax, 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 25 leading silver-producing companies in 1938, none of which produced less than 329,000 ounces, was 44,522,432 ounces—72 percent of the total mine output of the United States (Philippine Islands and Puerto Rico excluded); in 1937 the 25 leading companies produced 51,073,186 ounces, also 72 percent of the total mine output.

Largest producers of silver in the United States in 1938, 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	Copper ore, zinc-lead ore.
4	Phelps Dodge Corporation	Arizona	Ajo, 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	Polaris Mining Co	do	Evolution	Dry and siliceous ore.
9	American Metal Co. (Presidio mine).	Texas	Shafter	Do.
10	Hecla Mining Co	Idaho	Lelande	Lead ore, zinc-lead ore.
11	Park City Consolidated Mines Co.	Utah	Blue Lodge	Zinc-lead ore.
12	Federal Mining & Smelting Co.	Idaho	Hunter, Lelande, Yreka.	Do.
13	Snyder Mines, Inc	do	Warm Springs	Do.
14	Utah Copper Co	Utah	West Mountain	Copper ore.
15	Desert Silver, Inc	Nevada	Silver Peak	Silver ore.
16	Cactus Mines Co	California	Mojave	Dry and siliceous ore.
17	Eagle-Picher Mining & Smelting Co.	Arizona	Oro Blanco	Zinc-lead ore.
18	Veta Mines, Inc	do	Ash Peak	Dry and siliceous ore.
19	Anaconda Copper Mining Co. (Flathead mine).	Montana	Hog Heaven	Do.
20	Magma Copper Co	Arizona	Pioneer	Copper ore, copper-zinc ore.
21	Tonopah Mining Co. of Nevada.	Nevada	Tonopah	Gold-silver ore.
22	Silver King Coalition Mines Co.	Utah	Uintah	Zinc-lead ore, lead ore.
23	Black Hawk Consolidated Mines Co.	New Mexico	Mogollon	Dry and siliceous ore.
24	Chief Consolidated Mining Co.	Utah	Tintic	Dry and siliceous ore, lead ore, zinc-lead ore.
25	Shenandoah-Dives Mining Co.	Colorado	Animas	Dry and siliceous ore.

NUMBER OF MINES

The following table indicates the number of mines that produced gold and silver in 1937 and 1938. The placers are those in which the gold and the silver in natural alloy with the gold and, in a few placers, with 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, including those that yield ore valuable chiefly for copper, lead, or zinc but that contribute precious metals as byproducts. In addition to 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 and because much of the production is made by transitory miners not regularly working placer ground. So 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, 1937–38, by States [1]

State	Lode		Placer		Total	
	1937	1938	1937	1938	1937	1938
Alabama	2	1	2	2	4	3
Alaska [2]	61	70	1,177	1,164	1,238	1,234
Arizona	888	885	376	329	1,264	1,214
California	913	927	838	676	1,751	1,603
Colorado	655	669	490	592	1,145	1,261
Georgia	8	7	29	15	37	22
Idaho	347	305	741	463	1,088	768
Illinois [3]	2	2			2	2
Maryland	1	2			1	2
Michigan [3]	2	2			2	2
Missouri [3]	1	1			1	1
Montana	615	482	406	265	1,021	747
Nevada	682	795	117	130	799	925
New Mexico	159	166	160	164	319	330
New York [3]	1	1			1	1
North Carolina	7	14	5	6	12	20
Oregon	104	84	150	157	254	241
Pennsylvania	1	1			1	1
South Carolina	3	10	1	2	4	12
South Dakota	14	11	73	71	87	82
Tennessee [3]	3	3			3	3
Texas	7	7			7	7
Utah	189	183	14	22	203	205
Virginia [3]	3	3	3	1	6	4
Washington	65	77	90	80	155	157
Wyoming	3	8	27	26	30	34
	4,736	4,716	4,699	4,165	9,435	8,881

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

MINE PRODUCTION

SUMMARY

The following table gives the mine production of gold and silver in 1937 and 1938, by States, as reported to the Bureau of Mines by 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; and 1938 over 1937, 7 percent. The total gain in 1938 over 1933 was 97 percent. The output of silver decreased 13 percent in 1938 from 1937 but was still 170 percent above that in 1933.

Mine production of gold and silver in the United States, 1937–38, by regions and States, in terms of recovered metals

Region and State	Gold: Fine ounces 1937	Gold: Fine ounces 1938	Gold: Increase or decrease (percent)	Gold: Value (at $35 per ounce) 1937	Gold: Value (at $35 per ounce) 1938	Silver: Fine ounces 1937	Silver: Fine ounces 1938	Silver: Increase or decrease (percent)	Silver: Value 1937 (at $0.7735 per ounce)	Silver: Value 1938 (at $0.646+ per ounce)
Western States and Alaska:										
Alaska	627,940.00	664,973.00	+6	$21,977,900	$23,274,055	494,340	479,853	−3	$382,372	$310,208
Arizona	332,694.00	305,043.00	−8	11,644,290	10,676,505	9,422,552	7,479,153	−21	7,288,344	4,835,008
California	1,174,578.00	1,311,129.00	+12	41,110,230	45,889,515	2,888,265	2,590,804	−10	2,234,073	1,674,863
Colorado	368,905.00	367,468.00	[1]	12,911,675	12,861,380	6,260,693	7,932,095	+27	4,842,646	5,127,819
Idaho	81,861.00	103,513.00	+26	2,865,135	3,622,955	19,587,766	18,993,676	−3	15,151,137	12,278,740
Montana	202,252.00	203,313.00	+1	7,078,820	7,115,955	11,812,093	6,403,962	−46	9,136,654	4,139,935
Nevada	281,332.00	296,434.00	+5	9,846,620	10,375,190	4,864,750	4,355,471	−10	3,762,884	2,815,658
New Mexico	41,171.00	43,050.00	+5	1,440,985	1,506,750	1,243,766	1,229,860	−1	962,053	795,061
Oregon	52,662.00	81,729.00	+55	1,843,170	2,860,515	60,564	100,507	+66	46,846	64,974
South Dakota	581,544.00	594,847.00	+2	20,354,040	20,819,645	139,638	162,295	+16	108,010	104,918
Texas	562.00	439.00	−22	19,670	15,365	1,325,660	1,433,008	+8	1,025,398	926,389
Utah	322,759.00	200,630.00	−38	11,296,565	7,022,050	12,869,117	9,682,732	−25	9,954,262	6,259,544
Washington	36,310.00	74,175.00	+104	1,270,850	2,596,125	126,304	380,938	+202	97,696	246,263
Wyoming	1,776.00	798.00	−55	62,160	27,930	203	328	+62	157	212
	4,106,346.00	4,247,541.00	+3	143,722,110	148,663,935	71,095,711	61,224,682	−14	54,992,532	39,579,592
Eastern States:										
Alabama	2,459.89	41.00	−98	86,096	1,435	457	4	−99	353	3
Georgia	742.72	872.00	+17	25,995	30,520	49	71	+45	38	46
Maryland	1,040.00	855.00	−18	36,400	29,925	40	24	−40	31	16
New York	----	----	----	----	----	41,500	37,200	−10	32,100	24,048
North Carolina	948.65	1,878.00	+98	33,203	65,730	5,538	5,500	−1	4,284	3,556
Pennsylvania	1,348.00	1,422.00	+5	47,180	49,770	9,497	9,360	−1	7,346	6,051
South Carolina	2,482.56	11,681.00	+371	86,890	408,835	624	3,951	+533	483	2,554
Tennessee	263.00	236.00	−10	9,205	8,260	49,057	38,333	−22	37,946	24,781
Virginia	1,396.08	2,943.00	+111	48,863	103,005	111	502	+352	86	325
	10,680.90	19,928.00	+87	373,832	697,480	106,873	94,945	−11	82,667	61,380

Central States:										
Illinois						887	576	−35	686	372
Michigan	51.44		−100	1,800		25,454	93,634	+268	19,689	60,531
Missouri						179,700	292,000	+62	138,999	188,768
	51.44		−100	1,800		206,041	386,210	+87	159,374	249,671
Philippine Islands	[2] 716,967.00	[2] 903,265.00	+26	25,093,845	31,614,275	[2] 719,771	1,167,612	+62	556,743	754,820
Puerto Rico	17.00	9.00	−47	595	315	1	1		1	1
	716,984.00	903,274.00	+26	25,094,440	31,614,590	719,772	1,167,613	+62	556,744	754,821
	4,834,062.34	5,170,743.00	+7	169,192,182	180,976,005	72,128,397	62,873,450	−13	55,791,317	40,645,464

[1] Less than 0.1 percent.

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

Gold and silver produced in the Western States of the United States, 1848–1938, and in Alaska, 1880–1938, in terms of recovered metals

State	Period	Gold		Silver (fine ounces)
		Fine ounces	Value [1]	
Arizona	1860–1938	9,247,637	$211,162,450	246,290,559
California	1848–1938	95,963,031	2,060,809,737	95,919,085
Colorado	1858–1938	37,182,538	795,265,794	692,441,670
Idaho	1863–1938	7,216,200	155,706,403	418,127,937
Montana	1862–1938	15,897,268	340,857,592	679,367,364
Nevada	1859–1938	23,663,592	506,787,396	565,384,135
New Mexico	1848–1938	2,048,013	45,014,648	61,139,542
Oregon	1852–1938	5,317,449	114,073,758	4,489,124
South Dakota	1876–1938	18,232,108	419,720,989	8,832,407
Texas	1885–1938	7,099	182,410	28,749,634
Utah	1864–1938	8,068,483	182,621,945	646,973,710
Washington	1860–1938	1,624,993	35,630,078	10,013,622
Wyoming	1867–1938	76,090	1,771,478	74,297
Total, Western States	1848–1938	224,544,501	4,869,604,678	3,457,803,086
Alaska	1880–1938	23,023,856	518,849,562	18,978,413
Total, Western States and Alaska	1848–1938	247,568,357	5,388,454,240	3,476,781,499

[1] Gold valued per fine ounce as follows: Prior to 1933, \$20.67+; 1933, \$25.56; 1934, \$34.95; 1935–38, \$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 1938. 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.

Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38 [1]

1937

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	615, 614	0. 191	0. 70	72, 888	0. 149	5. 46	116, 447	0. 031	9. 43
California	4, 358, 184	. 153	. 23	58, 058	. 269	8. 35	56, 395	. 041	17. 14
Colorado	1, 291, 058	. 235	. 39	316, 105	. 086	1. 71	74, 020	. 004	9. 43
Idaho	203, 197	. 177	. 52	205	3. 537	87. 43	328, 112	. 002	43. 03
Montana	644, 596	. 202	. 46	13, 568	. 265	14. 46	246, 325	. 028	8. 03
Nevada	1, 219, 732	. 134	. 60	382, 715	. 080	3. 78	126, 601	. 047	9. 68
New Mexico	64, 682	. 136	. 43	68, 616	. 160	7. 34	955	. 006	10. 32
Oregon	74, 400	. 234	. 66				1		134. 00
South Dakota	1, 597, 178	. 363	. 09						
Texas	12	. 333					116, 141	. 005	11. 40
Utah	216, 787	. 220	2. 53	168, 769	. 155	5. 87	99, 596	. 049	19. 72
Washington	179, 850	. 200	. 49				1, 754	. 006	10. 19
Wyoming	17	9. 682	. 76						
Total, Western States	10, 465, 307	. 202	. 38	1, 080, 924	. 116	4. 23	1, 166, 347	. 022	20. 06
Alaska	4, 580, 923	. 051	. 03						
Eastern States	60, 542	. 138	. 02						
	15, 106, 772	. 156	. 27	1, 080, 924	. 116	4. 23	1, 166, 347	. 022	20. 06

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.

Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38—Continued

1937—Continued

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	19,928,824	0.009	0.32	29,969	0.078	7.50	59	0.068	13.10
California	447,248	.034	.66	5,009	.065	16.54			
Colorado	261,658	.046	15.86	30,235	.262	6.77	537	.005	21.26
Idaho	850	.026	43.08	412,378	.002	5.00			
Montana	3,426,395	.004	1.94	13,867	.076	10.52			
Nevada	5,669,388	.012	.05	11,218	.213	20.17	1,003	.016	6.62
New Mexico	3,631,454	.002	.06	1,853	.075	4.80	396	.006	13.37
Oregon	2,796	.332	2.06	3	5.333	15.33	30	2.300	10.67
South Dakota									
Texas	3,949		.56				43		.84
Utah	23,197,017	.009	.08	152,691	.069	10.69			
Washington	6,631	.002	.79	445		3.18			
Wyoming									
Total, Western States	56,576,210	.009	.35	657,668	.039	6.98	2,068	.045	11.84
Alaska	139,279		2.05						
Eastern States	[2] 2,565,535	.001	.02						
	59,281,024	.008	.34	657,668	.039	6.98	2,068	.045	11.84

State	Zinc ore			Zinc-lead ore			Total ore		
Western States:									
Arizona	91	0.022	0.99	212,467	0.080	3.91	20,976,359	0.016	0.45
California				120	.083	6.19	4,925,014	.143	.58
Colorado	135			94,871	.039	1.56	2,068,619	.171	3.03
Idaho				1,130,660	.003	2.86	2,075,402	.020	9.43
Montana	[3] 125,395	.002	.48	427,863	.022	5.81	4,898,009	.034	2.41
Nevada	103,305	.016	4.80	51,504	.014	8.53	7,565,466	.036	.64
New Mexico	170,510			252,626	.049	1.88	4,191,092	.009	.30
Oregon							77,230	.239	.72
South Dakota							1,597,178	.363	09
Texas							120,145	.005	11.03
Utah	173			743,242	.042	7.82	24,578,275	.013	.52
Washington				106,146		.13	294,826	.122	.43
Wyoming							17	9.682	.76
Total, Western States	399,609	.005	1.39	3,019,499	.026	4.45	73,367,632	.039	.96
Alaska							4,720,202	.050	.09
Eastern States	(4)			[5] 363,692		.12	2,989,769	.003	.04
	399,609	.005	1.39	3,383,191	.023	3.99	81,077,603	.038	.88

1938

State	Gold ore			Gold-silver ore			Silver ore		
Western States:									
Arizona	698,687	0.185	0.47	137,062	0.139	6.39	92,958	0.023	10.13
California	4,386,652	.160	.22	183,918	.193	7.21	9,892	.015	17.10
Colorado	1,071,562	.263	.34	379,456	.103	2.49	77,640	.004	9.89
Idaho	283,204	.142	.46	15,672	.135	5.79	444,456	.002	30.60
Montana	756,223	.201	.48	7,448	.293	15.69	150,930	.026	9.78
Nevada	1,399,728	.141	.42	230,783	.135	6.82	114,549	.031	11.19
New Mexico	26,149	.268	.75	82,017	.171	8.50	523	.009	15.24
Oregon	74,572	.366	1.17	351	.254	13.97	2		100.00
South Dakota	1,586,181	.374	.10						
Texas							130,923	.003	10.94
Utah	283,472	.146	1.15	184,346	.134	5.70	92,543	.046	18.35
Washington	271,557	.154	.47	61	.098	8.18	7,229	.010	15.30
Wyoming	580	.334	.37				1		34.00
Total, Western States	10,838,567	.204	.32	1,221,114	.138	5.47	1,121,646	.014	19.15
Alaska	4,767,545	.049	.03						
Eastern States	88,671	.199	.05						
	15,694,783	.157	.23	1,221,114	.138	5.47	1,121,646	.014	19.15

See footnotes at end of table.

Ores produced in the United States and average recovery in fine ounces of gold and silver per ton, 1937–38—Continued

1938—Continued

State	Copper ore			Lead ore			Lead-copper ore		
	Short tons	Average ounces per ton		Short tons	Average ounces per ton		Short tons	Average ounces per ton	
		Gold	Silver		Gold	Silver		Gold	Silver
Western States:									
Arizona	[6] 13,047,356	0.010	0.35	6,072	0.173	14.44	201	0.100	13.55
California	66,943	.034	.70	844	.504	21.95			
Colorado	333,103	.051	16.27	19,646	.336	8.61	37	.253	9.89
Idaho	165	.352	8.12	272,904	.003	5.31			
Montana	1,607,713	.003	2.40	10,574	.139	11.56			
Nevada	4,043,892	.012	.11	28,325	.110	5.37			
New Mexico	1,904,374	.003	.08	962	.201	6.50	303	.043	37.05
Oregon	9	1.111	.44	2	9.000	23.00			
South Dakota									
Texas	70		17.64	9	.059	8.56			
Utah	12,032,385	.008	.08	94,883	.056	11.73			
Washington	373,120	.082	.33	538	.004	6.16			
Wyoming									
Total, Western States	33,409,130	.010	.46	434,759	.044	7.18	541	.078	26.46
Alaska	89,174		2.89						
Eastern States	[2] 2,341,613	.001	.02						
	35,839,917	.010	.44	434,759	.044	7.18	541	.078	26.46

State	Zinc ore			Zinc-lead and zinc-copper ores [7]			Total ore		
Western States:									
Arizona	160	0.206	4.53	220,668	0.069	3.24	14,203,164	0.021	0.53
California							4,648,249	.159	.55
Colorado	145	.082	.57	114,506	.035	2.31	1,996,095	.175	3.97
Idaho				982,746	.005	3.77	1,999,147	.025	9.49
Montana	[3] 76,809		.12	114,769	.032	3.92	2,724,466	.062	2.35
Nevada				62,744	.018	5.12	5,880,021	.048	.74
New Mexico	182,822			217,707	.064	1.55	2,414,857	.017	.51
Oregon							74,936	.366	1.23
South Dakota							1,586,181	.374	.10
Texas							131,002	.003	10.94
Utah	83			560,948	.048	8.16	13,248,660	.015	.73
Washington				249,184		.06	901,689	.081	.42
Wyoming							581	.334	.43
Total, Western States	260,019		.04	2,523,272	.028	4.11	49,809,048	.057	1.22
Alaska							4,856,719	.048	.09
Eastern States	([4])			[5] 293,900		.13	2,724,184	.007	.03
	260,019		.04	2,817,172	.025	3.70	57,389,951	.054	1.07

[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] Current slag fumed.
[4] Zinc ore yielded no gold or silver.
[5] Figures cover following States—1937: New York and Tennessee; 1938: New York, North Carolina, and Tennessee.
[6] Includes 1,380,212 tons of ore leached which contained no gold or silver.
[7] Zinc-copper ore came from Arizona only.

Mine production of gold in the United States, 1937–38, by States and sources, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead and zinc-copper ores [2]	Total
1937								
Alabama	5	2,455						2,460
Alaska	393,591	234,319	30					627,940
Arizona	4,399	131,927	176,918	2,346	4	2	17,098	332,694
California	472,306	686,532	15,403	327			10	1,174,578
Colorado	14,871	330,361	12,015	7,920	3		3,735	368,905
Georgia	521	222						743
Maryland		1,040						1,040
Idaho	40,540	37,546	22	913			2,840	81,861
Michigan		51						51
Montana	36,397	140,857	14,151	1,047		236	9,564	202,252
Nevada	9,763	200,472	66,354	2,384	16	1,639	704	281,332
New Mexico	3,027	19,740	5,858	140	2	2	12,402	41,171
North Carolina	7	832	110					949
Oregon	34,219	17,429	929	16	69			52,662
Pennsylvania [3]			1,348					1,348
South Carolina	2	2,480						2,482
South Dakota	1,011	580,533						581,544
Tennessee			263					263
Texas		562						562
Utah	55	78,630	202,427	10,540			31,107	322,759
Virginia	97	1,299						1,396
Washington	371	35,925	14					36,310
Wyoming	1,611	165						1,776
	1,012,793	2,503,377	495,842	25,633	94	1,879	77,460	4,117,078
1938								
Alabama	11	30						41
Alaska	430,955	234,018						664,973
Arizona	4,985	150,371	133,409	1,048	20	33	15,177	305,043
California	572,513	735,896	2,295	425				1,311,129
Colorado	18,041	321,628	17,131	6,605	9	12	4,042	367,468
Georgia	578	294						872
Maryland		855						855
Idaho	54,079	43,493	58	831			5,052	103,513
Montana	35,348	157,906	4,965	1,471			3,623	203,313
Nevada	12,959	232,199	47,024	3,108			1,144	296,434
New Mexico	2,626	21,019	5,338	193	13		13,861	43,050
North Carolina	17	1,699	139				23	1,878
Oregon	54,331	27,370	10	18				81,729
Pennsylvania [3]			1,422					1,422
South Carolina	4	11,677						11,681
South Dakota	1,069	593,778						594,847
Tennessee			236					236
Texas		438		1				439
Utah	148	70,266	98,100	5,314			26,802	200,630
Virginia	57	2,886						2,943
Washington	1,575	41,948	30,650	2				74,175
Wyoming	604	194						798
	1,189,900	2,647,965	340,777	19,016	42	45	69,724	4,267,469

[1] Philippine Islands and Puerto Rico excluded.
[2] Zinc-copper ore in Arizona in 1938 only.
[3] From copper concentrates from magnetite-pyrite-chalcopyrite ore.

Mine production of silver in the United States, 1937–38, by States and sources, in fine ounces [1]

State	Placers	Dry and siliceous ore	Copper ore	Lead ore	Lead-copper ore	Zinc ore	Zinc-lead and zinc-copper ores [2]	Total
1937								
Alabama		457						457
Alaska	67, 095	141, 731	285, 514					494, 340
Arizona	649	1, 925, 271	6, 439, 903	224, 839	773	90	831, 027	9, 422, 552
California	40, 481	2, 471, 112	293, 065	82, 864			743	2, 888, 265
Colorado	2, 565	1, 744, 142	4, 150, 342	204, 554	11, 419		147, 671	6, 260, 693
Georgia	23	26						49
Idaho	12, 287	14, 243, 253	36, 622	2, 060, 761			3, 234, 843	19, 587, 766
Illinois [3]				887				887
Maryland		40						40
Michigan		8	25, 446					25, 454
Missouri				179, 700				179, 700
Montana	6, 415	2, 468, 049	6, 644, 653	145, 828		60, 295	2, 486, 853	11, 812, 093
Nevada	2, 531	3, 396, 755	297, 244	226, 287	6, 644	495, 967	439, 322	4, 864, 750
New Mexico	203	541, 183	214, 089	8, 902	5, 296	324	473, 769	1, 243, 766
New York							41, 500	41, 500
North Carolina		254	5, 284					5, 538
Oregon	5, 024	49, 406	5, 768	46	320			60, 564
Pennsylvania [4]			9, 497					9, 497
South Carolina		624						624
South Dakota	75	139, 563						139, 638
Tennessee			48, 207				850	49, 057
Texas		1, 323, 431	2, 193		36			1, 325, 660
Utah		3, 503, 118	1, 918, 080	1, 632, 958			5, 814, 961	12, 869, 117
Virginia	7	104						111
Washington	48	105, 325	5, 257	1, 414			14, 260	126, 304
Wyoming	190	13						203
	137, 593	32, 053, 865	20, 381, 164	4, 769, 040	24, 488	556, 676	13, 485, 799	71, 408, 625
1938								
Alabama	1	3						4
Alaska	63, 063	158, 637	258, 153					479, 853
Arizona	628	2, 147, 133	4, 525, 435	87, 700	2, 724	724	714, 809	7, 479, 153
California	49, 788	2, 475, 476	47, 016	18, 524				2, 590, 804
Colorado	3, 250	2, 073, 512	5, 421, 143	169, 223	366	83	264, 518	7, 932, 095
Georgia	35	36						71
Idaho	17, 328	13, 820, 791	1, 339	1, 449, 666			3, 704, 552	18, 993, 676
Illinois [3]				576				576
Maryland		24						24
Michigan			93, 634					93, 634
Missouri				292, 000				292, 000
Montana	6, 534	1, 956, 005	3, 859, 576	122, 203		9, 357	450, 287	6, 403, 962
Nevada	3, 208	3, 441, 276	437, 970	152, 074			320, 943	4, 355, 471
New Mexico	167	725, 138	150, 094	6, 258	11, 225		336, 978	1, 229, 860
New York							37, 200	37, 200
North Carolina		387	4, 907				206	5, 500
Oregon	8, 301	92, 156	4	46				100, 507
Pennsylvania [4]			9, 360					9, 360
South Carolina	1	3, 950						3, 951
South Dakota	82	162, 213						162, 295
Tennessee			37, 476				857	38, 333
Texas		1, 431, 696	1, 235	77				1, 433, 008
Utah	6	3, 075, 249	919, 224	1, 112, 585			4, 575, 668	9, 682, 732
Virginia	2	413	87					502
Washington	218	238, 514	124, 307	3, 315			14, 584	380, 938
Wyoming	79	249						328
	152, 691	31, 802, 858	15, 890, 960	3, 414, 247	14, 315	10, 164	10, 420, 602	61, 705, 837

[1] Philippine Islands and Puerto Rico excluded.
[2] Zinc-copper ore in Arizona in 1938 only.
[3] From fluorspar-lead ores.
[4] From copper concentrates from magnetite-pyrite-chalcopyrite ore.

Gold and silver produced in the United States from ore, old tailings, etc., 1937–38, by States and by methods of recovery [1]

State	Total ore, old tailings, etc., treated (short tons)	Ore, old tailings, etc., to gold and silver mills and bullion recovered				Ore and old tailings to concentrating mills (short tons)	Concentrates smelted (from gold and silver 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)
1937															
Alaska	4, 720, 202	4, 556, 978	----------	201, 563	37, 227	153, 516	28, 261	30, 319	299, 572	9, 708	2, 467	90, 446	----------	----------	----------
Arizona	20, 976, 359	431, 740	----------	63, 484	92, 405	18, 203, 790	669, 320	110, 428	3, 064, 430	2, 340, 829	154, 359	6, 264, 011	----------	24	1, 057
California	4, 925, 014	2, 949, 474	1, 279, 078	546, 296	938, 999	672, 677	54, 236	147, 330	1, 424, 149	23, 785	8, 646	484, 636	----------	----------	----------
Colorado	2, 068, 619	941, 765	----------	200, 338	78, 217	801, 391	78, 645	124, 574	1, 399, 562	325, 463	29, 122	4, 780, 349	----------	----------	----------
Idaho	2, 075, 402	145, 056	----------	21, 245	8, 477	1, 894, 447	294, 953	15, 127	18, 578, 929	35, 899	4, 949	988, 073	----------	----------	----------
Montana	4, 898, 009	396, 018	----------	63, 537	120, 638	4, 167, 560	655, 378	50, 024	9, 647, 795	213, 536	52, 294	2, 016, 574	120, 895	----------	20, 671
Nevada	7, 565, 466	813, 980	579, 153	107, 303	794, 101	5, 906, 118	314, 745	100, 743	1, 801, 746	266, 215	63, 523	2, 266, 372	----------	----------	----------
New Mexico	4, 191, 092	77, 209	----------	8, 349	258, 167	4, 057, 612	173, 830	22, 240	622, 011	56, 271	7, 555	363, 385	----------	----------	----------
Oregon	77, 230	14, 770	3, 807	2, 992	959	55, 191	5, 646	13, 430	46, 214	3, 462	2, 021	8, 367	----------	----------	----------
South Dakota	1, 597, 178	1, 597, 178	----------	579, 956	139, 473	----------	123	578	90	----------	----------	----------	----------	----------	----------
Texas	120, 145	110, 232	----------	453	899, 418	----------	806	108	321, 503	9, 913	1	104, 739	----------	----------	----------
Utah	24, 578, 275	127, 288	----------	11, 505	4, 123	23, 941, 803	910, 572	235, 271	7, 737, 160	509, 184	75, 928	5, 127, 834	----------	----------	----------
Washington	294, 826	142, 790	----------	22, 619	34, 611	114, 566	11, 536	3, 933	32, 313	37, 470	9, 387	59, 332	----------	----------	----------
Wyoming	17	8	----------	62	4	----------	----------	----------	----------	9	102	9	----------	----------	----------
Eastern States	[2]2, 989, 769	38, 617	----------	4, 044	739	2, 779, 655	49, 134	5, 773	91, 775	171, 497	232	14, 329	----------	----------	----------
	81, 077, 603	12, 343, 103	1, 862, 038	1, 833, 746	3, 407, 558	62, 748, 326	3, 247, 185	859, 878	45, 067, 249	4, 003, 241	410, 586	22, 568, 456	120, 895	24	21, 728
1938															
Alaska	4, 856, 719	4, 733, 174	----------	185, 208	33, 126	109, 846	21, 036	47, 567	265, 358	13, 699	1, 243	118, 306	----------	----------	----------
Arizona	14, 203, 164	616, 544	----------	75, 652	135, 257	10, 546, 807	547, 519	106, 505	2, 817, 824	1, 659, 601	117, 901	4, 525, 444	1, 380, 212	----------	----------
California	4, 648, 249	3, 267, 534	983, 955	569, 627	955, 017	384, 010	37, 902	158, 662	1, 314, 455	12, 750	10, 327	271, 544	----------	----------	----------
Colorado	1, 996, 095	991, 477	----------	212, 016	113, 963	627, 298	77, 893	102, 704	2, 017, 721	377, 320	34, 707	5, 797, 161	----------	----------	----------
Idaho	1, 999, 147	186, 163	----------	16, 314	8, 189	1, 779, 815	260, 462	26, 030	18, 099, 795	33, 169	7, 090	868, 364	----------	----------	----------
Montana	2, 724, 466	510, 711	----------	74, 251	122, 112	1, 976, 828	353, 378	34, 700	4, 724, 662	160, 118	59, 014	1, 541, 297	76, 809	----------	9, 357
Nevada	5, 880, 021	1, 031, 304	535, 071	151, 916	1, 380, 029	4, 134, 380	213, 300	74, 282	1, 128, 755	179, 266	57, 277	1, 843, 479	----------	----------	----------
New Mexico	2, 414, 857	84, 057	----------	9, 276	424, 310	2, 302, 992	146, 061	21, 199	485, 661	27, 808	9, 949	319, 722	----------	----------	----------
Oregon	74, 936	15, 198	12, 310	5, 563	1, 200	46, 008	2, 034	19, 772	85, 315	1, 420	2, 063	5, 691	----------	----------	----------
South Dakota	1, 586, 181	1, 586, 058	----------	590, 958	161, 379	----------	237	729	170	123	2, 091	664	----------	----------	----------
Texas	131, 002	127, 574	----------	384	1, 101, 131	----------	685	55	278, 056	3, 428	----------	53, 821	----------	----------	----------
Utah	13, 248, 660	197, 936	----------	14, 772	884	12, 597, 042	546, 903	126, 526	5, 504, 390	453, 682	59, 184	4, 177, 452	----------	----------	----------
Washington	901, 689	212, 161	----------	27, 500	57, 893	631, 864	52, 335	33, 549	248, 414	57, 664	11, 551	74, 413	----------	----------	----------
Wyoming	581	400	----------	77	13	----------	----------	----------	----------	181	117	236	----------	----------	----------
Eastern States	[2]2, 724, 184	87, 615	----------	13, 894	3, 709	2, 552, 140	54, 834	4, 152	82, 048	84, 429	1, 215	9, 149	----------	----------	----------
	57, 389, 951	13, 647, 906	1, 531, 336	1, 947, 408	4, 498, 212	37, 689, 030	2, 314, 579	756, 432	37, 052, 624	3, 064, 658	373, 729	19, 606, 743	1, 457, 021	----------	9, 357

[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, 1934–38 [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
1934	866, 336	250, 209	503, 482	1, 193, 450	31. 2	0. 8	18. 1	3. 6	24. 7	95. 3	26. 0	0. 3
1935	928, 949	433, 446	610, 144	1, 731, 622	28. 7	. 9	18. 8	3. 6	28. 7	95. 3	23. 7	. 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

[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, 1937–38, 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
1937										
Alaska	4, 554, 648	200, 671	36, 367	2, 374	892	860	31. 96	7. 36	0. 14	0. 17
Arizona	46, 654	5, 167	2. 393	385, 086	58, 317	90. 012	1. 55	. 03	17. 53	. 96
California	2, 442, 904	370, 004	214, 639	2, 171, 458	176, 292	724, 360	31. 50	7. 43	15. 01	25. 08
Colorado	673, 268	71, 135	15, 178	606, 551	129, 203	63, 039	19. 28	. 24	35. 02	1. 01
Idaho	65, 673	14, 348	5, 768	79, 383	6, 897	2, 709	17. 53	. 03	8. 43	. 01
Montana	85, 039	12, 955	2, 682	310, 979	50, 582	117, 956	6. 41	. 02	25. 01	1. 00
Nevada	486, 011	27, 420	19, 852	1, 005, 592	79, 883	774, 249	9. 75	. 41	28. 39	15. 92
New Mexico	1, 205	137	30	76, 004	8, 212	258, 137	. 33	------	19. 95	20. 75
Oregon	11, 590	2, 231	735	6, 988	761	224	4. 24	1. 21	1. 45	. 37
South Dakota	1, 414, 772	329, 975	66, 640	1, 576, 658	249, 981	72, 833	56. 74	47. 72	42. 99	52. 16
Texas	12	4	--------	109, 414	449	899, 418	. 71	------	79. 89	67. 85
Utah	20, 538	2, 186	2, 646	106, 750	9, 319	1, 477	. 68	. 02	2. 89	. 01
Washington	20, 375	2, 449	1, 278	122, 415	20, 170	33, 333	6. 74	1. 01	55. 55	26. 39
Wyoming	8	62	4	---------	-------	----------	3. 49	1. 97	------	------
Michigan	600	51	8	---------	-------	----------	100. 00	------	------	------
Eastern States	17, 982	1, 798	174	20, 635	2, 246	565	16. 83	. 16	21. 03	. 53
	9, 841, 279	1, 040, 593	368, 394	6, 580, 287	793, 204	3, 039, 172	25. 28	. 52	19. 27	4. 27
1938										
Alaska	4, 731, 094	183, 852	33, 059	2, 509	1, 356	67	27. 65	6. 89	. 20	. 01
Arizona	11, 177	1, 796	575	605, 367	73, 856	134, 682	. 59	. 01	24. 87	1. 80
California	2, 548, 159	337, 514	63, 930	2, 382, 255	232, 113	891, 087	25. 74	2. 47	17. 70	34. 39
Colorado	770, 788	69, 157	24, 114	591, 197	142, 859	89, 849	18. 82	. 30	38. 88	1. 13
Idaho	72, 477	13, 459	6, 311	113, 686	2, 855	1, 878	13. 00	. 03	2. 76	. 01
Montana	77, 478	9, 492	2, 050	433, 233	64, 759	120, 062	4. 67	. 03	31. 85	1. 87
Nevada	458, 485	35, 151	28, 901	1, 171, 140	116, 765	1, 351, 128	11. 86	. 66	39. 39	31. 02
New Mexico	19, 705	672	136	64, 352	8, 604	424, 174	1. 56	. 01	19. 99	34. 49
Oregon	6, 461	2, 952	608	21, 193	2, 611	592	3. 61	. 60	3. 19	. 59
South Dakota	1, 430, 391	328, 045	62, 602	1, 572, 566	262, 913	98, 777	55. 15	38. 57	44. 20	60. 86
Texas	---------	---------	--------	126, 889	384	1, 101, 131	------	------	87. 47	76. 84
Utah	7, 624	381	250	190, 312	14, 391	634	. 19	------	7. 17	. 01
Washington	2, 071	439	230	210, 090	27, 061	57, 663	. 59	. 06	36. 48	15. 14
Wyoming	400	77	13	---------	-------	----------	9. 65	3. 96	------	------
Eastern States	22, 229	1, 633	279	65, 386	12, 261	3, 430	8. 19	. 29	61. 53	3. 61
	10, 158, 539	984, 620	223, 058	7, 550, 175	962, 788	4, 275, 154	23. 07	. 36	22. 61	6. 97

[1] Philippine Islands and Puerto Rico excluded.

PLACERS

Dredging.—Placer gold is obtained largely from gravels handled by connected-bucket floating dredges, which recovered approximately 62 percent of the total output from placers in the United States (Philippine Islands and Puerto Rico excluded) in 1938 and 64 percent in 1937. The quantity of gold recovered by dredges from the inception of the industry as a commercial factor in 1896 to the end of 1938 is recorded as 15,822,938 ounces, originating by States as follows: California, 10,049,288 ounces; Alaska, 3,941,308 ounces (including some gold by hydraulicking); Montana, 553,129 ounces; Idaho, 453,067 ounces; Colorado, 420,387 ounces; Oregon, 371,295 ounces; and other States, 34,464 ounces. The output in 1938 was 736,424 ounces from 115 dredges, of which California produced 375,296 ounces from 48 dredges; Alaska, 278,442 ounces from 44 dredges; Idaho, 31,234 ounces from 9 dredges; Montana, 21,356 ounces from 6 dredges; Oregon, 29,006 ounces from 5 dredges; Colorado, 1,027 ounces from 2 dredges; and Nevada, 63 ounces from 1 dredge.

Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts

ALASKA

Company	Address	District	Number of dredges	
			1937	1938
Alluvial Gold, Inc.	Fairbanks	Circle	1	1
C. J. Berry Dredging Co.	Miller House	do	1	1
Deadwood Mining Co.	Fairbanks	do.[1]	2	1
Gold Placers, Inc.	do	do	1	1
Council Dredging Co.	Council	Council	1	1
Glass Dredging Co. (formerly Straub & Kimball)	do	do	1	1
Inland Dredging Co.	do	do	------	1
North Star Dredging Co.	do	do	1	1
United States Smelting, Refining & Mining Co., Fairbanks Department.	Fairbanks	Fairbanks	5	6
Arctic Circle Explorations, Inc. (formerly Keewalik Mining Co.).	Nome	Fairhaven	2	2
Forsgren Dredging Co.	Deering	do	1	1
Alaska Gold Dredging Corporation	Chicken	Fortymile	1	------
Boundary Dredging Co.	Jack Wade	do	------	1
North American Mines Co., Jack Wade Operations (formerly Jack Wade Dredging Co.).	do	do	1	1
Walker's Fork Gold Corporation	do	do	1	------
Bristol Bay Mining Co.	San Francisco	Goodnews Bay	------	1
American Creek Operating Co.	Fairbanks	Hot Springs	------	1
North American Dredging Co.	Flat	Iditarod	1	1
J. E. Riley Investment Co.	do	do	1	1
Holky Dredging Co. (Ganes Creek Dredging Co. to Oct. 8, 1937).	Ophir	Innoko	1	1
W. F. Puntila	Takotna	do	1	1
Savage & Matheson	do	do	1	1
N. J. Vibe (formerly Felder & Gale)	Ohpir	do	1	1
Fox Bar Dredging Co.	Nome	Kougarok	1	1
Kougarok Consolidated Placers	do	do	1	1
Dime Creek Dredging Co. (Wallace Porter)	Haycock	Koyuk	1	1
Shaw & Cook	Golovin	do	------	1
Ungalik Syndicate	do	do	------	1
Alaska Sunset Mines Corporation	Nome	Nome	1	1
Dry Creek Dredging Co.	do	do	1	1
Greenstone Mines, Inc.	do	do	1	------
Osborn 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	1
Casa de Paga Gold Co.	Nome	Solomon	1	1
Lee Brothers Dredging Co.	do	do	1	1
Spruce Creek Dredging Co.	do	do	1	------
New York Alaska Gold Dredging Co.	Nyac	Tuluksak-Aniak	2	2
			41	44

[1] Fairbanks district in 1937.

Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts—Continued

CALIFORNIA

Company	Address	District	Number of dredges 1937	Number of dredges 1938
Yuba Consolidated Gold Fields	San Francisco	Callahan	1	1
Camanche Placers, Ltd	Camanche	Camanche	1	1
Comanche Gold Dredging Co	San Francisco	do	1	1
Lancha Plana Gold Dredging Co	Camanche	do	1	1
George V. & C. W. Neilsen	do	do	1	------
Wallace Dredging Co	San Francisco	do	1	1
Cosumnes Gold Dredging Co	do	Cosumnes River	1	1
Capital Dredging Co	do	Folsom	3	3
Natomas Co	Sacramento	do	6	7
Sacramento Gold Dredging Co	San Francisco	do	1	------
Cal Oro Dredging Co	do	Greenhorn	1	1
Yreka Gold Dredging Co	do	do	1	1
D. D. Dodson (Staheli)	Red Bluff	Igo	1	------
Roaring River Gold Dredging Co	San Francisco	do	1	1
Arroyo Seco Gold Dredging Co	do	Ione [2]	2	2
Lancha Plana Gold Dredging Co	Camanche	do. [3]	1	1
California Gold Dredging Co	San Francisco	Jenny Lind	------	1
Charles James Thompson	Linden	do	------	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
Lewiston Gold Dredging Co	Lewiston	Lewiston	1	1
Trinity Gold Dredging Co	do	do	1	1
Bill & McCoy Dredging Co	Chico	Magalia	1	------
Antelope Creek Dredging Co	San Francisco	Ophir	1	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. [4]	1	1
Yuba Consolidated Gold Fields	do	do	1	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
Yuba Consolidated Gold Fields	do	Yuba River	5	5
			46	48

COLORADO

Company	Address	District	1937	1938
Timberline Dredging Co	Denver	Beaver Creek	------	1
Continental Dredging Co	Breckenridge	Breckenridge	1	1
			1	2

IDAHO

Company	Address	District	1937	1938
Fisher-Baumhoff Co	Centerville	Boise Basin	2	2
The Grimes Co	Pioneerville	do	1	1
Moores Creek Dredging Co	Idaho City	do	1	1
Jordan Creek Placers	De Lamar	Carson	1	1
Mount Vernon Mining Co	Orogrande	Elk City, Oro Grande.	1	1
Baumhoff-Fisher Co. (formerly Little Smoky Dredging Co)	Centerville	Little Smoky	------	1
Gold Creek Placer Co	Pierce	Pierce	1	------
Gold Dredging, Inc	do	do	1	------
Warren Dredging Co	Warren	Warren	1	1
Baumhoff-Fisher Co	do	do	1	1
			10	9

[2] Mother Lode district in 1937.
[3] Lancha Plana district in 1937.
[4] Folsom district until March 11, 1937.

Connected-bucket floating gold dredges operated in the United States, 1937–38, by companies and districts—Continued

MONTANA

Company	Address	District	Number of dredges 1937	Number of dredges 1938
Winston Bros. Co	Helena	Clancey		1
Porter Bros. Corporation	do	Helena	1	1
Perry-Schroeder Mining Co	do	Missouri River		1
Homer Wilson	Harrison	Norris	1	1
Pioneer Placer Dredging Co	Gold Creek	Pioneer	1	1
Gold Creek Mining Co	Deer Lodge	Washington		1
			3	6

NEVADA

Company	Address	District	1937	1938
Manhattan Gold Dredging Co	Manhattan	Manhattan		1

OREGON

Company	Address	District	1937	1938
Western Dredging Co	San Francisco	Canyon	1	1
Porter & Co	Helena	Granite		1
Rogue River Gold Co	Rogue River	Greenback	1	1
Sumpter Valley Dredging Co	Portland	Sumpter	1	1
Timms Gold Dredging Co	Galena	Susanville	1	1
			4	5

Gold produced in the United States by connected-bucket floating dredges, 1934–38, in fine ounces

Year	Dredges	California	Alaska	Other States [1]	Total
1934	74	193, 773	269, 082	49, 940	512, 795
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

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

Other placer-mining methods.—From 1932 through 1938 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 1938 approximately 26 percent of the total output of placer gold, including Alaska and excluding the Philippine Islands, was recovered at these plants, and 12 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 Minerals Yearbook and Mineral Resources.

PRODUCTION IN PHILIPPINE ISLANDS

The value of the gold produced in the Philippine Islands from 1907 to 1938, inclusive, is computed at $155,605,126. The gold production in 1938 was 903,265 ounces valued at $31,614,275 compared with 716,967 ounces valued at $25,093,845 in 1937, an increase of 26 percent. The annual value of the output from 1929 to 1938 was as follows:

Mine production of gold in the Philippine Islands, 1929–38

Year	Gold (fine ounces)	Value [1]	Year	Gold (fine ounces)	Value [1]
1929	160,620	$3,320,300	1934	340,314	$11,893,975
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

[1] Gold valued per fine ounce as follows: Prior to 1933, $20.67; 1933, $25.56; 1934, $34.95; 1935–38, $35.
[2] Division of Statistics, Department of Agriculture and Commerce, Manila.

The largest producers of gold, in approximate order of importance in 1938 included: Balatoc Mining Co., Benguet Consolidated Mining Co., Antamok Goldfields Mining Co., Itogon Mining Co., Masbate Consolidated Mining Co., I. X. L. Mining Co., San Mauricio Mining Co., United Paracale Mining Co., Coco Grove, Inc., Demonstration Gold Mines, Ltd., Baguio Gold Mining Co., and Suyoc Consolidated Mining Co., each of which produced over 22,000 ounces of gold; in all, they produced about 734,000 ounces. Of the total gold output in 1938, lode mines yielded 853,168 ounces, gravel handled by dredges 34,973 ounces, and other placers 15,124 ounces. Two dredges, each equipped with approximately 80 4-cubic foot buckets, were operated at Paracale, Camarines Norte, by Coco Grove, Inc., and one dredge by Tambis Gold Dredging Co., Inc., at Lianga, Surigao.

The output of silver from the Philippine Islands in 1938 was 1,167,612 ounces, all produced as a byproduct of gold mining.

COPPER

By J. W. Furness and H. M. Meyer

SUMMARY OUTLINE

World rates of copper production and consumption in 1938 fell below the records attained in 1937, largely because of the unsatisfactory demand for metal in the United States. Outside of the United States consumption was larger than ever before, being 8 percent above the previous record established in 1937, while that in the United States was 41 percent below 1937 and 54 percent below the previous record consumption in 1929.

Production at domestic mines, primary smelters, and refineries in 1938 failed by about one-third to pace the 1937 rate. Demand for copper was at an extremely low level in the early months of 1938. As a consequence, production was reduced at many properties and was suspended at some others. By July output was at the lowest level of the year, being little more than one-half the rate for January.

Curtailment of output in the middle of the year resulted in bringing new supply below consumption requirements; and stocks, which were 43 percent higher at the end of May than at the beginning of the year, were reduced successively from May to the end of October a total of 103,000 tons. Production increased after July, and following the consumption peak reached in October stocks turned upward again in November and December. Inventories of refined copper at domestic primary refineries were 181,000 tons at the end of 1938 compared with 179,000 tons at the end of 1937, while those of blister and unrefined copper at smelters, in transit to refineries, and at refineries were 233,000 and 214,000 tons, respectively. According to the Copper Institute stocks of refined copper abroad fell from 211,844 tons at the end of 1937 to 167,413 at the end of 1938. Foreign stocks declined in every month of the year except June and December. The average monthly rate of consumption abroad was very high all year, but requirements for armament and industry were unable to absorb the increased tonnages available in the final quarter, with the result, already noted, that stocks increased more than 12,000 tons in December.

The unsatisfactory level of consumption in the United States was caused largely by unfavorable industrial conditions in general and particularly by the inability of some large copper-consuming industries, such as the utility industry, to call for even their proportionate share of the total. The failure to find a solution for the problems of the railroads also deterred consumption. The record consumption abroad was due largely to the large amounts needed for armament. Statistics showing how much copper was withdrawn for stock-pile purposes are not available; but it seems safe to assume that Germany and Japan, at least, did not actually consume all the copper made available during the past 2 or 3 years. Consumption for industrial purposes abroad was restricted in several countries because of the urgent needs for military purposes. Despite the record-breaking level of foreign demand in 1937 and 1938 total requirements for copper might have been larger had political uncertainties been removed and industrial uses been permitted to expand.

Because of the better level of consumption in foreign countries in 1938 selling conditions during the year frequently were more favorable in London than in New York; exports of domestic copper were higher than in any other year since 1928 and were about equal to those in that year. According to the Copper Institute, 125,852 tons of duty-free domestic copper were sold abroad in 1938 compared with 62,798 tons in 1937. Total exports of refined copper aggregated 370,545 and 295,064 tons, respectively.

Sales of copper on the Commodity Exchange were larger than ever before as this market assumed increasing importance to the copper industry. In the last 2 months of the year, when the producers' price for copper delivered at Connecticut points was held at 11.25 cents in the face of falling demand, sales on the Commodity Exchange were 3½ times as large as producers' sales, and the discounts amounted to as much as 1 to 1.25 cents a pound. Commodity Exchange sales were 75 percent of those on the London Metal Exchange in 1938.

Salient statistics of the copper industry in the United States, 1925–29 (average) and 1935–38, in short tons

	Average (1925–29)	1935	1936	1937	1938
New copper produced—					
From domestic ores, as reported by—					
Mines	885, 826	380, 491	614, 516	841, 998	557, 763
Ore produced:					
Copper ore	59, 505, 871	[1] 19, 112, 054	[1] 38, 514, 245	[1,2] 61, 513, 148	(3)
Average yield of copper percent	1. 44	1. 89	1. 54	1. 29	(3)
Smelters	892, 730	381, 294	611, 410	834, 661	562, 328
Percent of world total	51	23	32	32	25
Refineries	890, 767	338, 321	645, 462	822, 253	552, 574
From foreign ores, matte, etc., refinery reports	317, 287	250, 484	177, 027	244, 561	239, 842
Total new refined, domestic and foreign	1, 208, 054	588, 805	822, 489	1, 066, 814	792, 416
Secondary copper recovered from old scrap only	347, 512	361, 700	382, 700	408, 900	267, 300
Copper content of copper sulfate produced by refiners	4, 601	3, 376	4, 642	5, 855	4, 978
Total production, new and old and domestic and foreign	1, 560, 167	953, 881	1, 209, 831	1, 481, 569	1, 064, 694
Imports (unmanufactured) [4]	391, 212	257, 182	190, 339	279, 875	252, 164
Refined [4]	59, 236	18, 071	4, 782	7, 487	1, 802
Exports of metallic copper [5]	522, 616	295, 198	259, 032	346, 229	421, 012
Refined (ingots, bars, rods, etc.)	482, 868	275, 006	236, 091	310, 396	385, 223
Stocks at end of year	307, 200	411, 000	305, 500	393, 000	414, 000
Refined copper	86, 100	175, 000	110, 000	179, 000	181, 000
Blister and materials in solution	221, 100	236, 000	195, 500	214, 000	233, 000
Withdrawals from total supply on domestic account:					
Total new copper	778, 123	441, 371	656, 179	[6] 694, 906	406, 994
Total new and old copper	1, 288, 700	890, 000	1, 141, 000	[6] 1, 227, 000	767, 000
Price, average ......cents per pound	14. 7	8. 3	9. 2	12. 1	9. 8
World smelter production, new copper	1, 761, 000	1, 681, 000	1, 895, 000	2, 583, 000	[7] 2, 228, 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] Revised figures.
[7] Approximate.

Several outstanding developments in the world copper industry during the last decade have had a pronounced effect on the price of copper and in the international trade in this commodity. Perhaps the most important of these has been the remarkable growth in the production of the British Empire to a point where the Empire now has an exportable surplus. Contemporaneous with this expansion there has been a substantial increase in South American production, most of which is controlled by subsidiaries of United States companies. Both sources apparently can produce copper at a cost considerably below the average cost of production in the United States; in consequence, the position formerly enjoyed by domestic producers in the international market, particularly in Great Britain, Germany, and France, has been weakened to a considerable degree. With minor exceptions, exports from the United States, have decreased steadily, and more and more domestic producers are forced to depend on the home market for absorption of their mine output. During 1938, as already has been mentioned, exports from the United States increased materially, but as this was due largely to the abnormal demand abroad for armament it can be considered only a temporary situation.

The effects of these developments on price have been twofold. First, the competition between relatively low-cost producers in the British Empire and South America has reduced our previous conceptions of normal copper prices by several cents per pound. Secondly, London has replaced New York as the dominant copper market of the world because of the afore-mentioned competition on the London metal exchange. Meanwhile the domestic producer faces the problem of preserving the home market for domestic metal under tariff protection and at the same time of marketing his surplus production abroad at a price that seldom has equaled the New York quotation. This situation has been a disturbing influence in the foreign copper market because exportation of domestic metal when the foreign price is below the domestic creates instability in the London market. Likewise, when the foreign price exceeds the domestic the export of domestic metal not only threatens a shortage in the domestic market but affects prices as well.

Another factor that has had an important influence on world price has been the ever-increasing supply of secondary copper. In the United States the differential between the domestic price of secondary and primary copper is relatively constant because the higher grades of secondary copper are directly competitive with virgin metal in some uses. For example, wire bars may be manufactured from what is known in the scrap trade as No. 1 and No. 2 copper wire and No. 1 heavy copper. In purchasing his raw material the consumer weighs the differential between scrap and virgin against the cost of refurnacing scrap. In consequence, virgin copper prices are very sensitive to changes in scrap prices. The United States leads the world as a source of scrap, and from time to time Japan, Germany, and Great Britain buy large tonnages, usually at a price slightly higher than current domestic prices. These foreign purchases of scrap add another disturbing factor to the domestic price situation.

Chile occupies a unique and powerful position in the international copper trade. The resources of copper in Chile are far greater than those developed so far in either Canada or South Africa and as a matter of fact are larger than the combined total for these two countries. It is evident from the reports published that the Chuquicamata deposit contains more metallic copper than do the combined deposits of Rhodesia and the Congo. The largest mines of Chile are controlled by citizens of the United States, and as these mines can produce copper at a price that cannot be equaled by any group of mines throughout the world on a similar tonnage basis they occupy a strategic position in the industry. Recognizing this, some of the other foreign producers at the time the International Cartel was formed argued that the Chilean output should be considered in the same category with the domestic production of the United States in that it was controlled by the United States and that due to the tariff situation the United States market was closed to all other producers.

Chile's position has effectively blocked the imposition of a British tariff on copper. When this question was discussed at the Ottawa Conference of British Dominions in 1932 a resolution was passed that, at any time the Dominions considered it expedient, a 4-cent duty should be placed upon all copper entering the British Empire other than that produced from British possessions. This tariff has never been applied.

The fact that United States producers, through their Chilean subsidiaries, could flood the international market at any time with large tonnages of copper produced at a very low figure gives them a trading advantage that unquestionably has been a factor in forestalling the British tariff and has been used to maintain Chile's quota in international trade. Fear of the disastrous competition that would result from collapse of the cartel is the major factor that will preserve it.

The price for copper ordinarily has been subjected to considerable fluctuation, and the greatest sales usually are made on a rising market. This philosophy is diametrically opposed to that of the nickel and aluminum industries, which have attempted to maintain relatively stable prices for their products for many years The theory of these industries is that wide fluctuations of price disturb the channels through which the metal flows to the consumer and that, should prices vary to a great degree, a loss of market would ensue that could not be recaptured without expending large sums of money.

In the metal trades one of the great factors invariably controlling price is substitution, which in many instances is largely a matter of price. In view of the inroads other metals are making in the consumption of copper in transmission lines and other outlets it might well be assumed that in the near future world copper producers will endeavor to meet this competition by further price stabilization.

The Bureau of Mines published a report [1] on the history, geology, prospecting, exploration, development, and mining of copper in North America.

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 source of production; and refinery statistics give precise information regarding metal recovered 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.

Copper produced from domestic ores, as reported by mines, smelters, and refineries, 1934–38, in pounds

Year	Mine	Smelter	Refinery
1934	474, 803, 458	488, 454, 107	466, 058, 360
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

PRIMARY COPPER

Smelter production.—The recovery of copper by United States smelters from ores of domestic origin totaled 1,124,656,539 pounds in 1938, a decrease of 33 percent from 1937. Smelter domestic output constituted 51 percent of world production in the period 1925–29.

[1] Gardner, E. D., Johnson, C. H. and Butler, B. S., Copper Mining in North America: Bureau of Mines Bull. 405, 1938, 300 pp.

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 but declined again to 25 percent in 1938.

The figures for smelter production in 1938 are based on 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, 1934–38

[Smelter output, in pounds fine]

State	1934	1935	1936	1937	1938
Alabama	10,972	10,061	14,293	18,820	
Alaska	130,284	14,601,603	30,421,557	42,215,119	33,492,746
Arizona	168,408,450	278,519,397	414,144,129	580,493,036	420,351,310
California	232,845	1,629,735	10,327,582	10,615,215	1,680,754
Colorado	13,046,759	14,340,744	19,181,339	21,826,209	30,563,654
Idaho	1,717,895	2,124,725	2,924,763	4,804,162	5,611,392
Michigan	51,681,901	73,811,562	91,105,431	84,751,478	75,281,469
Missouri	46,276	85,166	464,418	695,569	625,844
Montana	67,005,217	157,760,435	215,433,377	280,662,270	156,249,794
Nevada	41,922,506	72,818,792	146,154,075	149,963,847	93,655,642
New Mexico	26,994,219	4,559,874	6,974,705	63,573,985	43,913,133
North Carolina	(1)	(1)	(1)	(1)	(1)
Oklahoma	10,723				
Oregon	41,422	372,093	566,388	870,102	88,670
Pennsylvania	(1)	(1)	(1)	(1)	(1)
South Carolina	421	7,796		136	7,893
Tennessee	(1)	(1)	(1)	(1)	(1)
Texas	32,956	17,995	55,336	316,102	35,740
Utah	96,223,463	120,972,668	261,202,190	404,168,742	229,876,860
Virginia	384	683		953	43,279
Washington	33,393	81,482	201,944	124,422	12,494,297
Wyoming	3,390	1,749	42	75	155
Undistributed	20,910,631	20,870,780	23,647,827	24,222,036	20,683,907
	488,454,107	762,587,340	1,222,819,396	1,669,322,278	1,124,656,539

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

Copper produced (smelter output) in the United States, 1934–38, and total, 1845–1938

[Values rounded]

Year	Short tons	Value
1934	244,227	$39,076,000
1935	381,294	63,295,000
1936	611,410	112,499,000
1937	834,661	201,988,000
1938	562,328	110,216,000
Total, 1845–1938	25,876,719	7,898,331,000

Mine production.—The figures for mine production are based on reports furnished 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 1938 was 1,115,525,160 pounds, a decrease of 34 percent over that in 1937 and 37 percent below the average for 1925–29.

Production by States and districts.—The following tables show mine and smelter production by States for 1937 and 1938 and by districts for 1934–38. In 1938 Arizona, Utah, and Montana led in production, with 72 percent of the smelter total compared with 76 percent in 1937. If the output of Nevada and Michigan is added to the above, 87 percent of the output of the country is represented compared with 90 percent in 1937. Arizona's proportion of the total increased from 35 percent in 1937 to 37 in 1938. Utah's dropped from 24 to 20 percent, and Montana's fell from 17 to 14. Nevada's proportion was slightly lower than in 1937 while Michigan's share was nearly 2 percent more than the all-time low percentage registered in that year. Of the most important copper-producing States, Arizona, Utah, and Nevada supplied a much larger percentage of the total for 1938 than they did during the period 1845–1938, while Michigan and Montana contributed a much smaller proportion.

Copper produced in the United States, according to smelter and mine returns, by States, 1937–38, and 1845–1938, in short tons

	1937		1938			1845-1938, Smelter output	
			Smelter returns				
	Smelter returns	Mine returns	Percent of total	Quantity	Mine returns	Total quantity	Percent of total
Alabama	9	4	----	----	----	(1)	(1)
Alaska	21,108	17,336	2.98	16,746	14,549	676,472	2.62
Arizona	290,247	288,478	37.38	210,176	210,797	8,535,965	32.99
California	5,308	5,251	.15	840	806	559,661	2.16
Colorado	10,913	10,934	2.72	15,282	14,171	239,072	.92
Idaho	2,402	2,232	.50	2,806	2,139	81,934	.32
Michigan	42,376	47,464	6.69	37,641	46,743	4,500,189	17.39
Missouri	348	269	.06	313	----	(1)	(1)
Montana	140,331	144,528	13.89	78,125	77,213	5,723,218	22.12
Nevada	74,982	74,603	8.33	46,828	46,169	1,229,916	4.75
New Mexico	31,787	32,053	3.90	21,956	20,439	828,929	3.20
North Carolina	(2)	(2)	(2)	(2)	(2)	(1)	(1)
Oregon	435	410	.01	44	38	11,302	.04
Pennsylvania	(2)	(2)	(2)	(2)	(2)	(1)	(1)
South Carolina	(3)	1	----	4	(2)	(1)	(1)
Tennessee	(2)	(2)	(2)	(2)	(2)	[4] 259,508	[4] 1.00
Texas	158	160	----	18	16	(1)	(1)
Utah	202,084	205,994	20.44	114,938	108,126	2,985,300	11.54
Virginia	(3)	(3)	----	22	(2)	(1)	(1)
Washington	62	64	1.11	6,247	6,017	20,720	.08
Wyoming	(3)	----	----	----	----	15,863	.06
Undistributed	12,111	12,217	1.84	10,342	10,540	[5] 208,670	.81
	834,661	841,998	100.00	562,328	557,763	25,876,719	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 1929–38 are confidential and are included under "Undistributed."
5 Includes Tennessee for 1929–38.

The Bingham (Utah) district again produced more copper than any other district in 1938, followed as in 1937 by Butte, Mont. The Bisbee (Ariz.) district stood third in 1938, having replaced Globe-Miami, Ariz., which held that position in 1937.

Details of mine production, by districts and companies, in 1938, are available in other chapters of this volume dealing with production of gold, silver, copper, lead, and zinc in the various States.

Mine production of copper in the principal districts,[1] 1934–38, in terms of recovered copper, in short tons

District or region	State	1934	1935	1936	1937	1938
Bingham	Utah	41,793	63,060	124,453	203,421	106,049
Butte	Montana	31,428	76,964	109,004	143,879	76,855
Bisbee (Warren)	Arizona	35,555	32,281	39,842	55,991	47,518
Lake Superior	Michigan	24,108	32,054	47,984	47,464	46,743
Globe-Miami	Arizona	7,161	18,680	55,668	88,509	44,528
Ajo	do	(2)	33,560	48,020	55,375	43,180
Ely (Robinson)	Nevada	20,467	32,815	57,580	56,706	38,501
Yavapai County (mostly Jerome district)	Arizona	13,199	38,086	50,327	43,403	29,437
Pioneer	do	16,367	15,874	16,224	17,104	17,167
Central (including Santa Rita)	New Mexico	10,895	1,547	2,213	29,464	16,557
Ray (Mineral Creek)	Arizona		1	7	17,308	15,029
Copper River	Alaska	(3)	[4] 7,750	[4] 18,850	[4] 17,336	[4] 14,549
Red Cliff (Battle Mountain)	Colorado	4,910	6,592	7,966	9,458	12,013
Morenci-Metcalf	Arizona	6	1	6	6,822	11,148
Cope	Nevada		3,973	12,557	16,588	6,563
Chelan	Washington					5,931
Lordsburg	New Mexico		39	408	1,904	3,173
Coeur d'Alene region	Idaho	736	987	1,315	1,944	1,883
San Juan Mountains	Colorado	585	536	721	1,142	1,819
Bunker Hill	Arizona	2	16	623	1,396	1,626
Tintic	Utah	573	882	856	1,331	1,177
Plumas County	California		827	4,239	4,939	602
Swain County [5]	North Carolina	(2)	(2)	(2)	(2)	(2)
Lebanon (Cornwall mine) [5]	Pennsylvania	(2)	(2)	(2)	(2)	(2)
Ducktown [5]	Tennessee	(2)	(2)	(2)	(2)	(2)

[1] Districts producing 1,000 short tons or more in any year of the period, 1934–38.
[2] Bureau of Mines not at liberty to publish figures.
[3] Total for Alaska was 57 tons in 1934.
[4] Includes a small quantity produced elsewhere in Alaska.
[5] Not listed in order of output.

The following table shows the output of copper in the principal districts in the United States from 1910–38:

Mine production of copper in the principal districts in the United States, 1910–38, in terms of recovered copper

[Includes copper recovered from precipitates]

Year	Bingham, Utah			Silver Bow County, Mont.			Globe-Miami, Ariz.			Yavapai County, Ariz.		
	Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced	
		Thousands of pounds	Percent		Thousands of pounds	Percent		Thousands of pounds	Percent		Thousands of pounds	Percent
1910	5,427,953	113,725	1.05	4,709,429	284,265	3.02	311,996	[1] 27,600	4.42	417,308	40,825	4.89
1911	6,044,893	129,996	1.08	4,569,942	272,271	2.98	735,345	49,010	3.33	245,165	36,104	7.36
1912	6,567,948	116,622	.89	5,243,935	308,223	2.94	1,449,013	[2] 61,412	2.12	406,053	34,043	4.19
1913	9,190,374	144,920	.79	5,612,530	285,682	2.55	1,497,506	71,250	2.38	447,659	38,720	4.32
1914	7,800,661	141,925	.91	4,749,189	232,189	2.44	1,510,593	72,895	2.41	459,982	34,058	3.70
1915	9,693,184	176,593	.91	5,574,105	266,006	2.39	2,569,508	102,914	2.00	614,843	59,229	4.82
1916	12,777,683	223,620	.88	7,209,835	349,538	2.42	7,683,015	[3] 220,039	1.43	967,558	109,526	5.66
1917	14,150,394	225,412	.80	5,681,058	270,593	2.38	5,947,681	[4] 169,417	1.42	1,176,644	159,612	6.78
1918	13,607,650	211,195	.78	7,394,038	321,107	2.17	7,710,708	201,806	1.31	1,301,828	148,883	5.72
1919	6,086,379	116,697	.96	3,907,089	169,053	2.16	6,280,470	171,106	1.36	738,221	80,228	5.43
1920	6,067,180	110,670	.91	5,013,847	176,404	1.76	7,348,437	176,215	1.20	1,038,243	114,937	5.54
1921	1,538,309	28,011	.91	1,141,013	47,958	2.10	2,870,072	76,488	1.33	191,964	26,576	6.92
1922	4,745,810	91,762	.97	4,010,759	165,374	2.06	6,255,277	170,035	1.36	601,389	76,608	6.37
1923	11,829,839	216,037	.91	5,261,344	223,043	2.12	8,006,991	198,426	1.24	1,594,268	147,718	4.63
1924	12,708,560	236,181	.93	4,192,371	247,365	2.95	8,412,183	190,452	1.13	1,407,479	143,348	5.09
1925	13,140,350	227,612	.87	3,862,401	266,637	3.45	8,500,300	175,272	1.03	1,544,507	154,017	4.99
1926	14,521,472	248,975	.86	3,985,585	252,991	3.17	9,802,958	175,386	.89	1,595,826	155,368	4.87
1927	14,519,121	249,919	.86	3,753,246	221,312	2.95	9,760,831	171,167	.88	1,575,476	141,642	4.50
1928	17,251,706	287,685	.83	3,896,048	247,067	3.17	9,574,474	160,430	.84	1,890,830	165,297	4.37
1929	18,515,213	311,892	.84	4,271,213	296,316	3.47	11,293,656	191,596	.85	2,255,441	208,172	4.62
1930	10,134,900	175,070	.86	2,351,836	195,472	4.16	9,740,546	158,120	.81	1,395,527	117,690	4.22
1931	8,485,873	147,706	.87	1,869,348	184,362	4.93	7,429,571	126,444	.85	431,174	44,576	5.17
1932	3,465,178	62,469	.90	652,967	84,608	6.48	1,994,452	28,448	.71	264,213	35,809	6.78
1933	3,833,509	71,636	.93	613,752	65,239	5.32	470	259	27.55	257,125	33,258	6.47
1934	4,502,819	83,586	.93	644,487	62,856	4.88	356,522	14,322	2.01	315,552	26,398	4.18
1935	7,055,212	126,121	.89	1,611,448	153,929	4.78	1,171,101	37,359	1.60	1,078,906	76,172	3.53
1936	14,258,656	248,906	.87	2,796,273	218,008	3.90	5,541,666	111,336	1.00	1,589,843	100,654	3.17
1937	23,720,375	406,842	.86	3,684,972	287,757	3.90	9,734,324	177,018	.91	1,579,696	86,805	2.75
1938	12,507,863	212,099	.85	1,623,736	153,710	4.73	4,824,508	89,055	.92	1,049,615	58,875	2.80

[1] Smelter production.
[2] Excludes copper in 58,836 tons of old slag.
[3] Excludes copper in 483 tons of old slag.
[4] Excludes copper in 700 tons of old slag.

Mine production of copper in the principal districts in the United States, 1910–38, in terms of recovered copper—Continued

Year	Bisbee (Warren), Ariz.			Ely (Robinson), Nev.			Lake Superior, Mich.			Central, N. Mex.		
	Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced		Ore and old tailings (short tons)	Copper produced	
		Thousands of pounds	Percent		Thousands of pounds	Percent		Thousands of pounds	Percent		Thousands of pounds	Percent
1910	1, 191, 124	140, 235	5. 89	2, 375, 032	63, 914	1. 35	10, 869, 561	222, 683	1. 02	37, 008	2, 680	3. 62
1911	1, 095, 895	128, 767	5. 88	2, 776, 930	67, 034	1. 21	10, 978, 827	219, 840	1. 00	45, 584	1, 413	1. 55
1912	1, 238, 408	138, 703	5. 60	3, 023, 082	67, 374	1. 11	11, 411, 941	218, 138	. 96	1, 136, 290	29, 513	1. 30
1913	1, 416, 483	158, 006	5. 58	3, 447, 812	71, 917	1. 04	7, 016, 370	135, 853	. 97	1, 948, 471	51, 696	1. 33
1914	1, 401, 833	151, 613	5. 41	2, 749, 913	51, 090	. 93	9, 269, 413	164, 344	. 89	1, 934, 020	55, 223	1. 43
1915	1, 662, 249	164, 667	4. 95	3, 206, 133	64, 662	1. 01	12, 334, 700	265, 283	1. 07	2, 395, 795	66, 581	1. 39
1916	[5] 1, 996, 408	[6] 193, 696	4. 85	4, 053, 950	93, 045	1. 15	12, 364, 114	273, 693	1. 08	3, 134, 791	74, 229	1. 18
1917	1, 687, 112	167, 599	4. 97	4, 467, 709	93, 627	1. 05	12, 400, 723	255, 710	. 99	3, 668, 289	82, 200	1. 12
1918	1, 632, 210	160, 456	4. 92	4, 520, 936	92, 420	1. 02	11, 321, 365	226, 794	. 96	3, 908, 816	77, 547	. 99
1919	1, 256, 967	122, 311	4. 87	2, 273, 961	47, 871	1. 05	7, 690, 253	178, 826	1. 16	1, 789, 083	40, 359	1. 13
1920	1, 457, 471	118, 448	4. 06	2, 589, 546	48, 348	. 93	5, 938, 967	154, 695	1. 30	1, 882, 172	44, 400	1. 18
1921	386, 929	37, 249	4. 81	400, 810	10, 283	1. 28	3, 610, 648	86, 370	1. 20	362, 331	9, 138	1. 26
1922	772, 482	79, 591	5. 15	630, 871	22, 615	1. 79	4, 952, 264	121, 712	1. 23	1, 426, 783	28, 408	1. 00
1923	1, 727, 694	123, 884	3. 59	2, 833, 674	65, 928	1. 16	5, 363, 160	138, 304	1. 29	2, 885, 711	54, 375	. 94
1924	2, 547, 736	140, 630	2. 76	3, 505, 362	73, 279	1. 05	5, 372, 572	135, 663	1. 26	2, 859, 688	66, 824	1. 17
1925	2, 529, 459	145, 433	2. 88	3, 922, 770	78, 627	1. 00	7, 036, 751	155, 157	1. 10	3, 159, 167	68, 812	1. 09
1926	2, 520, 503	140, 668	2. 79	4, 672, 240	95, 009	1. 02	7, 641, 682	175, 382	1. 15	3, 633, 821	75, 219	1. 04
1927	[7]	138, 595	[7]	4, 488, 009	107, 441	1. 20	8, 046, 334	177, 538	1. 10	3, 087, 823	66, 971	1. 08
1928	2, 395, 271	161, 492	3. 37	5, 730, 471	141, 969	1. 24	7, 361, 658	178, 443	1. 21	3, 723, 753	80, 239	1. 08
1929	2, 796, 419	186, 130	3. 33	6, 378, 138	130, 755	1. 03	7, 598, 180	186, 402	1. 23	4, 135, 864	87, 446	1. 06
1930	1, 978, 297	127, 900	3. 23	3, 999, 077	105, 385	1. 32	6, 659, 036	169, 381	1. 27	2, 667, 267	57, 243	1. 07
1931	1, 186, 213	95, 328	4. 02	2, 945, 270	71, 334	1. 21	3, 570, 748	118, 059	1. 65	2, 714, 360	56, 317	1. 04
1932	260, 284	47, 405	9. 11	1, 374, 039	30, 885	1. 12	1, 142, 775	54, 396	2. 38	1, 231, 876	26, 513	1. 08
1933	[7]	55, 796	[7]	1, 220, 700	28, 189	1. 15	697, 158	46, 853	3. 36	1, 239, 379	25, 142	1. 01
1934	521, 963	71, 111	6. 81	1, 861, 417	40, 934	1. 10	700, 055	48, 216	3. 44	1, 137, 259	21, 790	. 96
1935	600, 659	64, 563	5. 37	2, 931, 749	65, 630	1. 12	1, 376, 803	64, 109	2. 33	172, 561	3, 095	. 90
1936	844, 620	79, 684	4. 72	4, 643, 146	115, 161	1. 24	3, 225, 600	95, 968	1. 49	218, 468	4, 427	1. 01
1937	1, 086, 259	111, 983	5. 15	5, 565, 522	113, 412	1. 02	4, 197, 881	94, 928	1. 13	3, 784, 450	58, 929	. 78
1938	919, 185	95, 037	5. 17	3, 997, 090	77, 002	. 96	3, 757, 705	93, 486	1. 24	1, 987, 688	33, 114	. 83

[5] Excludes 73,657 tons of old slag.
[6] Excludes copper in 73,657 tons of old slag.
[7] Data not available.

Quantity and estimated recoverable content of copper-bearing ores.—The following tables list the quantity and the estimated recoverable copper content of the ore produced by United States mines in 1937; figures for 1938 are not yet available. Of the total copper produced from copper ores in the United States in 1937, 85 percent was obtained from ores concentrated before smelting and 15 percent from direct-smelting ore. No ore was treated by straight leaching in 1937, but 9,724,841 tons were treated by combined leaching and flotation. Straight leaching of copper ores was resumed in 1938. The percentages for 1937 are to be compared with 80 percent obtained from concentrated ore and 20 percent from direct-smelting ores in 1936. Better prices, followed by larger-scale operations and the treatment of lower-grade ores, resulted in the higher ratio of concentrating ores to smelting ores in 1937. It is reasonable to assume that the ratio declined in 1938 with the reversal of 1937 conditions.

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 1937, 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	19, 928, 824	[2] 550, 186, 231	1. 38	176, 918	6, 439, 903	$0. 56
California	447, 248	9, 891, 800	1. 11	15, 403	293, 065	1. 71
Colorado	261, 658	19, 403, 425	3. 71	12, 015	4, 150, 342	13. 88
Idaho	850	145, 450	8. 56	22	36, 622	34. 23
Michigan	4, 197, 881	94, 928, 000	1. 13	----------	25, 446	----------
Montana	3, 426, 395	[2] 277, 430, 398	4. 05	14, 151	6, 644, 653	1. 64
Nevada	5, 669, 388	147, 956, 900	1. 30	66, 354	297, 244	. 45
New Mexico	3, 631, 454	61, 463, 565	. 85	5, 858	214, 089	. 10
Oregon	2, 796	284, 700	5. 09	929	5, 768	13. 22
Texas	3, 949	272, 000	3. 44	----------	2, 193	. 43
Utah	23, 197, 017	[2] 396, 990, 931	. 86	202, 427	1, 918, 080	. 37
Washington	6, 631	114, 731	. 87	14	5, 257	. 69
Eastern States	[3] 739, 057	24, 405, 550	1. 65	1, 721	62, 988	. 15
	[1 3] 61, 513, 148	[1] 1, 583, 473, 681	[1] 1. 29	[1] 495, 812	[1] 20, 095, 650	[1]. 53

[1] Exclusive of Alaska, figures for which the Bureau of Mines is not at liberty to publish.
[2] Excludes copper recovered from precipitates as follows: Arizona, 24,683,500 pounds; Montana, 9,614,024 pounds; and Utah, 4,839,088 pounds.
[3] Includes copper concentrates from pyritiferous magnetite ore from Pennsylvania.

Copper ore, old tailings, etc., concentrated [1] in the United States [2] in 1937, 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] 17,727,531	620,372	[3] 362,394,062	1.02
California	447,050	21,435	9,875,300	1.10
Michigan	4,197,881	74,086	94,928,000	1.13
Montana	3,375,679	531,964	272,790,057	4.04
Nevada	5,630,634	261,130	132,755,635	1.18
New Mexico	3,602,172	100,829	58,992,000	.82
Utah	23,194,800	592,018	396,681,231	.86
Washington	6,555	235	99,893	.76
Eastern States	[4] 555,620	40,897	17,176,900	[5] 1.51
	[2] 58,737,922	[2] 2,242,966	[2] 1,345,693,078	[2] 1.15

[1] Includes 9,724,841 tons of copper ore treated by combined leaching and flotation.
[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, 70,878,191 pounds of which were recovered as electrolytic copper.
[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 1937, with content in terms of recovered copper and copper produced from all sources, in terms of recovered copper

State	Ore, old tailings, etc., smelted			Copper from all sources, including old slags, smelter cleanings, and precipitates (pounds)
	Short tons	Copper produced (pounds)	Percent of copper	
Alaska	(2)	(2)	(2)	34,672,000
Arizona	2,201,293	187,792,169	4.27	[3] 576,956,000
California	198	16,500	4.17	10,502,000
Colorado	261,658	19,403,425	3.71	21,868,000
Idaho	850	145,450	8.56	4,464,000
Michigan				94,928,000
Missouri				538,000
Montana	50,716	4,640,341	4.57	[3] 289,056,000
Nevada	38,754	15,201,265	19.61	149,206,000
New Mexico	29,282	2,471,565	4.22	64,106,000
Oregon	2,796	284,700	5.09	820,000
Texas	3,949	272,000	3.44	320,000
Utah	2,217	309,700	6.98	[4] 411,988,000
Washington	76	14,838	9.76	128,000
Eastern States	171,395	7,228,650	2.11	24,444,000
	[1] 2,763,184	[1] 237,780,603	[1] 4.30	1,683,996,000

[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 precipitates.
[4] Considerable copper was recovered from precipitates and from ores classed as zinc-lead and dry and siliceous ores.

Copper ores produced in the United States, 1933–37, and average yield in copper, gold, and silver

Year	Smelting ores		Concentrating ores [1]		Total				
	Short tons	Yield in copper (percent)	Short tons	Yield in copper (percent)	Short tons [1]	Yield in copper (percent)	Yield per ton in gold (ounce)	Yield per ton in silver (ounce)	Value per ton in gold and silver
1933	872,033	6.30	7,475,988	1.63	8,387,612	2.11	0.0126	0.696	$0.57
1934	977,096	6.21	10,681,967	1.53	11,723,638	1.92	.0124	.661	.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

[1] Includes old tailings, etc.
[2] Includes old tailings, etc. Exclusive of small quantities 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 1938 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 four refineries west of the Great Lakes—one at Great Falls, Mont.; one at Tacoma, Wash.; one at El Paso, Tex.; and one at Clifton, Ariz. Of the above plants the lake refinery of the Quincy Mining Co. and the plant of the Phelps Dodge Corporation that produces furnace-refined copper at Clifton, Ariz., have been idle since 1933.

In addition to the plants mentioned above those at Ajo and Inspiration, Ariz., are 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 Ajo plant has been idle since 1931.

The above 14 plants constitute what commonly are termed "regular refineries." Of these plants 10 employ the electrolytic process and 4 the furnace process. The electrolytic plants, excluding the Ajo unit which is no longer active, have a rated capacity of 1,642,000 tons of refined copper per annum. As they produced but 849,000 tons in 1938, only 52 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, 1934–38, in pounds

	1934	1935	1936	1937	1938
Primary:					
Domestic: [1]					
Electrolytic	414, 020, 483	[2] 602, 826, 051	1, 198, 132, 177	[2] 1, 548, 857, 307	[2] 1, 032, 976, 656
Lake	51, 681, 901	[2] 73, 605, 212	91, 105, 431	[2] 84, 007, 120	[2] 72, 021, 341
Casting	355, 976	211, 603	1, 686, 587	11, 640, 702	150, 326
	466, 058, 360	676, 642, 866	1, 290, 924, 195	1, 644, 505, 129	1, 105, 148, 323
Foreign: [1]					
Electrolytic	424, 523, 995	500, 878, 984	353, 817, 802	486, 285, 376	479, 635, 732
Casting and best select	137, 510	88, 947	235, 413	2, 837, 298	47, 674
Refinery production, new copper	890, 719, 865	1, 177, 610, 797	1, 644, 977, 410	2, 133, 627, 803	1, 584, 831, 729
Imports refined copper [3]	54, 833, 436	36, 142, 671	9, 563, 232	14, 974, 815	3, 603, 025
Total new refined copper made available	945, 553, 301	1, 213, 753, 468	1, 654, 540, 642	2, 148, 602, 618	1, 588, 434, 754
Secondary:					
Electrolytic	243, 189, 320	296, 028, 315	265, 437, 556	[4] 312, 831, 103	[4] 185, 084, 601
Casting	720, 514	927, 450	392, 167	380, 000	
	243, 909, 834	296, 955, 765	265, 829, 723	313, 211, 103	185, 084, 601
Grand total	1, 189, 463, 135	1, 510, 709, 233	1, 920, 370, 365	2, 461, 813, 721	1, 773, 519, 355

[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 in 1937–38

Form	1937		1938	
	Pounds	Percent	Pounds	Percent
Wire bars	1, 295, 000, 000	52. 92	825, 000, 000	46. 61
Cathodes	555, 000, 000	22. 68	522, 000, 000	29. 49
Cakes	297, 000, 000	12. 14	215, 000, 000	12. 15
Ingots	133, 000, 000	5. 44	88, 000, 000	4. 97
Other forms	167, 000, 000	6. 82	120, 000, 000	6. 78
	2, 447, 000, 000	100. 00	1, 770, 000, 000	100. 00

Besides 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 39,081,407 pounds having a copper content of 9,955,000 pounds in 1938 compared with 45,968,040 pounds having a copper content of 11,709,000 pounds in 1937.

The output of copper sulfate by plants other than the regular primary refineries was 49,819,375 pounds with a reported copper content of 12,565,000 pounds in 1938 compared with 48,538,693 pounds containing 12,235,000 pounds in 1937.

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 the past 5 years. 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

The production of secondary copper and that by domestic mines decreased similarly in 1938—32 percent and 34 percent, respectively—and in consequence the ratio of secondary to primary was about the same as in 1937. When mine activity was at an extremely low level in 1933 secondary output was 177 percent of mine output; it declined to 63 percent in 1937 and was 65 percent in 1938.

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 1938 it was 1,588,434,754 pounds, a 26-percent decrease from 1937. 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.

New refined copper withdrawn from total year's supply on domestic account, 1934–38, in pounds

	1934	1935	1936	1937	1938
Total supply of new copper	945,553,301	1,213,753,468	1,654,540,642	2,148,602,618	1,588,434,754
Stock at beginning of year	813,000,000	569,000,000	350,000,000	220,000,000	358,000,000
Total available supply	1,758,553,301	1,782,753,468	2,004,540,642	2,368,602,618	1,946,434,754
Copper exported [1]	544,276,582	550,012,320	472,182,922	620,791,029	770,446,945
Stock at end of year	569,000,000	350,000,000	220,000,000	358,000,000	362,000,000
	1,113,276,582	900,012,320	692,182,922	[2] 978,791,029	1,132,446,945
Withdrawn on domestic account	645,276,719	882,741,148	1,312,357,720	[2] 1,389,811,589	813,987,809

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

As shown in the foregoing table, the quantity of new copper withdrawn on domestic account in 1938 was 41 percent less than in 1937 and 54 percent less than in the record year 1929.

Total supply.—Adding 719,600,000 pounds of secondary copper and copper in alloys produced during the year to the 814,000,000 pounds of new refined copper withdrawn on domestic account gives a total supply of 1,533,600,000 pounds of new and old copper available for domestic consumption in 1938. The secondary copper, however, includes remelted new scrap as well as old scrap. The new scrap represents a revolving supply required in manufacturing, so that a more significant figure of supply available for domestic consumption is obtained by adding to the new refined copper only the secondary copper derived from old scrap (534,600,000 pounds). The total available for consumption by this calculation would be 1,348,600,000 pounds in 1938 compared with 2,207,600,000 in 1937 and 2,587,000,000 in 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, 1934–38, in short tons

Use	1934	1935	1936	1937	1938
Electrical manufactures [1]	101, 000	128, 000	164, 000	212, 000	150, 000
Telephones and telegraphs	18, 000	18, 000	26, 000	40, 000	30, 000
Light and power lines [2]	36, 000	55, 500	72, 000	83, 000	62, 000
Wire cloth	4, 600	5, 600	6, 500	6, 800	6, 000
Other rod and wire [3]	40, 000	48, 000	90, 000	102, 000	60, 000
Ammunition	13, 500	13, 700	11, 900	14, 100	12, 500
Automobiles [4]	63, 000	95, 000	108, 000	112, 000	55, 000
Buildings [5]	36, 000	49, 000	71, 000	70, 500	67, 500
Castings, n. e. s.[6]	36, 000	36, 000	39, 000	40, 000	31, 000
Clocks and watches	2, 200	2, 400	3, 400	4, 000	3, 000
Copper-bearing steel [9]	2, 100	2, 300	3, 900	4, 600	2, 600
Radiators, heating	1, 000	1, 100	2, 000	2, 100	2, 000
Radio receiving sets	12, 500	16, 000	24, 000	23, 100	17, 500
Railway equipment [7]	2, 100	1, 800	4, 000	7, 100	1, 700
Refrigerators [8]	15, 700	15, 400	15, 000	13, 500	6, 700
Shipbuilding [8]	3, 200	1, 100	5, 000	6, 400	6, 000
Air conditioning [8] [9]	3, 800	4, 800	6, 400	7, 200	6, 100
Other uses [10]	46, 800	51, 500	65, 300	66, 600	46, 200
Manufactures for export	25, 500	29. 500	31, 600	45, 000	39, 200
	463, 000	574, 700	749, 000	860, 000	605, 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, etc., all reckoned in terms of copper content.

The foregoing table shows that the use of copper in automobiles in 1938 declined more sharply in relation to 1937 than any other important use for copper; it was 51 percent below 1937 and 60 percent below 1929. The total copper used fell 30 percent from 1937, according to these figures, and was 48 percent lower than in 1929. Although copper used in telephone and telegraph equipment dropped proportionately less than the total for 1938, consumption for this purpose made the poorest showing in relation to 1929, having fallen 82 percent below that year. Light and power lines declined 25 percent in 1938, and other rod and wire fell 41 percent. Government stimulation of the building industry must have been partly responsible for the fact that consumption of copper by this industry held up better than in any other, being only 4 percent below 1937 and 14 percent above 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, 1935–39, in pounds

Year	Refined copper	Blister and materials in process of refining	Year	Refined copper	Blister and materials in process of refining
1935	569, 000, 000	389, 000, 000	1938	358, 000, 000	428, 000, 000
1936	350, 000, 000	472, 000, 000	1939	362, 000, 000	466, 000, 000
1937	220, 000, 000	391, 000, 000			

Stocks of refined copper at refineries were 1 percent higher at the end of 1938 than at the end of 1937; those of blister and unrefined copper at smelters, in transit to refineries, and at refineries were 9 percent higher; and total refined and unrefined stocks increased 5 percent.

Figures of the Copper Institute, quoted in the press, indicated that world stocks aggregated 457,168 short tons at the end of 1938, a 3-percent decrease from the beginning of the year. This decline was due to smaller stocks in foreign countries, where inventories fell from 211,844 to 167,413 tons (21 percent), for stocks of refined, duty-free copper in the United States increased from 259,351 to 289,755 tons (12 percent). These figures do not show the extensive changes during the year. In the United States the excess of production over low domestic requirements in the first 5 months of the year resulted in stocks increasing 43 percent by the end of May. Improved demand and reduced domestic output caused a drop of more than 100,000 tons in inventories by the end of October; then stocks increased. Refined stocks abroad fell from 211,844 tons at the end of 1937 to 155,049 tons at the end of November 1938. They increased 12,364 tons to reach 167,413 at the end of December. According to the Copper Institute, blister stocks gained 5,861 tons in the United States but declined 4,218 tons abroad in 1938. 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, as shown in the foregoing table, were 181,000 tons at the end of 1938 and 179,000 tons at the end of 1937 (compared with 289,755 and 259,351 tons).

Data for consumers' stocks are not available.

PRICES

Reports to the Bureau of Mines from copper-selling agencies indicate that 615,000 short tons of copper were delivered to domestic and foreign purchasers in 1938 at an average price (f. o. b. refinery) of 9.8 cents a pound compared with 12.1 cents in 1937 and 9.2 in 1936.

The producers' quotation for copper delivered at Connecticut points was 10.12½ cents at the beginning of 1938. It rose ¾ cent in the early part of January, fell ⅞ cent in the latter part of the month, and declined 1 cent more to 9 cents in May, the lowest price for the year. During the first 5 months of the year demand in the United States was at a very low level, and producers' sales to domestic customers totaled only 22,600 tons or about half the monthly average for all of 1937. During these months domestic output was well ahead of domestic consumption and exports, and large additions to inventories were being made. Announcements in May and June of important reductions in operating rates at domestic mines (already made or to be made), in complete summer shut-downs for some properties, and in a reduction of 10 percent in the rate for the cartel group, resulted in easing of the selling pressure. On June 30 sales of copper totaled 30,954 tons and in the week of June 27–July 2, 118,660 tons, or more than the 112,889 tons sold during the first 5 months of the year. Apparent domestic consumption advanced from May until the high point of the year was reached in October, and stocks of refined copper declined more than 100,000 tons during that period. The price was raised 1⅛ cents a pound in July, ¼ cent in September, and ⅞ cent in October to 11.25 cents, the highest quotation for the year. Consumption abroad was at high levels throughout the year, and refined stocks were reduced every month (with one exception) from January through November. War fears are believed to have been largely responsible for the relative scarcity of spot metal abroad in October. The cartel moved quickly in announcing increased production rates in October, in an evident effort to prevent a run-away market, and market tension eased. By October domestic production more than doubled the lowest monthly rate—that for July. Demand declined after October, but production continued to increase and producers' sales to domestic consumers fell to 10,800 tons in November and 15,100 tons in December, the lowest monthly sales reported for the entire year. During the last 2 months of the year domestic refined stocks increased, and in December foreign stocks rose sharply.

For a large part of the year selling conditions abroad were more favorable than in the United States, and exports of domestic copper were maintained at a relatively steady rate throughout the year; in all, they were higher than in any year since 1928. November and December producers' prices were maintained at 11.25 cents a pound in the face of very light sales.

Most of the copper disposed of during November and December was sold on the Commodity Exchange, at discounts of as much as 1–1.25 cents a pound. The importance of this facility for dealing in Standard copper has increased greatly in recent years. Before it was established London was the only large market where copper could be freely traded in, but in recent years activity on the New York Commodity Exchange has permitted the American industry to conduct its hedging operations at home. Sales of Standard copper on the Commodity Exchange were approximately 25 percent of those on the London Metal Exchange in 1936, 50 percent in 1937, and 75 percent in 1938.

Average monthly quoted prices of electrolytic copper for domestic and export shipments, f. o. b. refineries, United States, and for spot copper at London, 1937–38, in cents per pound

Month	1937				1938			
	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	12.55	12.415	12.112	12.332	10.30	10.198	9.908	10.131
February	13.46	13.427	13.828	13.985	9.87	9.775	9.525	9.759
March	15.87	15.775	16.590	16.611	9.87	9.775	9.496	9.698
April	15.22	15.121	14.692	14.620	9.87	9.775	9.443	9.653
May	13.87	13.775	13.999	14.044	9.47	9.375	8.801	9.059
June	13.87	13.775	13.492	13.531	8.87	8.775	8.500	8.725
July	13.87	13.775	13.817	13.927	9.68	9.585	9.573	9.771
August	13.87	13.775	13.926	14.145	10.00	9.900	9.844	10.003
September	13.65	13.530	12.984	13.038	10.13	10.028	9.943	10.111
October	11.93	11.838	11.207	11.197	10.86	10.760	10.713	10.897
November	10.90	10.797	9.850	9.819	11.12	11.025	10.569	10.735
December	10.11	10.005	9.714	9.789	11.12	11.025	10.023	10.214
Average for year	13.27	13.167	13.018	13.097	10.10	10.000	9.695	9.912

[1] As reported by the American Metal Market Co.
[2] As reported by Engineering and Mining Journal.
[3] Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

Average yearly quoted prices of electrolytic copper for domestic and export shipment, f. o. b. refineries, United States, and for spot copper at London, 1929–38, in cents per pound

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Domestic f. o. b. refinery [1]	18.23	13.11	8.24	5.67	7.15	8.53	8.76	9.58	13.27	10.10
Domestic f. o. b. refinery [2]	18.107	12.982	8.116	5.555	7.025	8.428	8.649	9.474	13.167	10.000
Export f. o. b. refinery [2]	(3)	(3)	(3)	(3)	6.713	7.271	7.538	9.230	13.018	9.695
London spot [2] [4]	18.413	13.355	8.522	5.629	6.877	7.496	7.753	9.465	13.097	9.912

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.

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-nine percent by weight of the copper imported in 1938 was contained in ore, concentrates, and unrefined furnace products. Most of the remainder consisted of ingots to be remelted and recast in the United States. By contrast, 95 percent of the exports comprised refined copper and primary manufactures therefrom.

The United States has long had an exportable surplus of copper and exported more copper than it imported for many years. 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 rose sharply in 1938, owing to frequent periods during the year when selling conditions abroad were better than in this country. Excess of total exports over imports of unmanufactured copper rose from 141,000,000 pounds in 1937 to 340,000,000 pounds in 1938. 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.—Imports of all classes of unmanufactured copper except concentrates declined in 1938, the total being 10 percent below 1937. Imports of ore from Chile, Cyprus, and Mexico were sharply lower in 1938 than in 1937. Receipts of copper in concentrates gained in 1938 because of increased quantities from Mexico, Canada, and Cuba, for those from other important sources declined. More unrefined copper was received from Canada and Turkey in 1938 than in 1937, but the decline in imports from Chile, Mexico, and Yugoslavia more than offset the increase from those countries. Imports of refined copper from Chile dropped sharply in 1938.

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.

Copper (unmanufactured) imported into the United States in 1938, 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	----------	524, 579	2, 186	3, 315, 531	----------	----------
Other South	----------	395, 180	----------	8, 511, 346	----------	----------
Argentina	102, 505	----------	55, 810	----------	----------	533, 483
Australia	694, 200	3, 523, 713	712, 196	----------	----------	4, 621
Bolivia	450, 126	4. 782, 588	565	----------	----------	----------
Canada	1, 081, 168	49, 591, 580	2, 622, 920	33, 346, 397	32, 246	1, 065. 179
Chile	6, 258, 821	2, 866, 356	47, 555	122, 105, 569	3, 570, 520	619, 795
Cuba	112, 446	34, 528, 499	----------	722, 898	----------	317, 902
Malta, Gozo, and Cyprus Islands	2, 858, 240	----------	----------	----------	----------	----------
Mexico	1, 736, 290	11, 735, 317	18, 930	80, 792, 612	----------	----------
Newfoundland and Labrador	----------	13, 160, 455	----------	----------	----------	----------
Peru	1, 633, 185	184, 082	132, 416	78, 300, 553	----------	----------
Philippine Islands	500	2, 320, 179	318, 768	15, 365	----------	----------
Turkey	----------	----------	----------	5, 087, 752	----------	----------
United Kingdom	----------	----------	283, 776	219, 213	259	23, 708
Yugoslavia	----------	----------	----------	21, 164, 326	----------	----------
Other countries	31, 900	892, 303	843, 704	15, 000	----------	60, 466
	14, 959, 381	124, 504, 831	5, 038, 826	353, 596, 562	3, 603, 025	2, 625, 154

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

Copper (unmanufactured) imported[1] *into the United States, 1934–38*

Year	Pounds	Year	Pounds
1934	426, 571, 568	1937	559, 749, 133
1935	514, 364, 526	1938	504, 327, 779
1936	380, 677, 700		

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

Exports.—Exports of all classes of copper totaled 844,027,426 pounds in 1938, an increase of 20 percent over 1937, and were the largest since 1929; they amounted to 80 percent of the average for 1925–29. The gain in total shipments of copper abroad is explained mainly by the largely increased exports of refined copper (the principal class of exports) to countries that were either at war or anticipating war—Germany, Japan, Czechoslovakia, and Poland—for exports to other large customers, such as the United Kingdom and France, dropped. Germany received the principal part of the old and scrap copper exported, about the same quantity as in 1937, while Japan's imports of this class fell sharply.

Copper exported from the United States in 1938,[1] in pounds

Country	Ore, concentrates, composition metal, and unrefined copper (copper content)	Refined		Old and scrap	Pipes and tubes	Plates and sheets	Wire (except insulated)	Insulated wire and cable	Other copper manufactures
		Bars, ingots, or other forms	Rods						
Argentina	----------	5, 027, 540	545	----------	73, 535	25, 051	154, 650	720, 838	
Belgium	1, 180, 927	18, 349, 877	841, 632	1, 439, 900	292	----------	2, 006	72, 144	
Brazil	----------	3, 478, 531	484, 364	----------	171, 941	21, 724	259, 817	522, 305	
Canada	4, 300	1, 563, 120	865, 373	75, 337	274, 905	114, 185	28, 392	541, 688	
China	----------	951, 964	68	67, 196	8, 065	11, 698	3, 254, 114	193, 104	
Cuba	----------	23, 208	18, 851	----------	213, 273	58, 881	227, 285	1, 580, 996	
Czechoslovakia	----------	66, 827, 737	----------	2, 697, 506	----------	----------	14, 502	1, 618	
Denmark	----------	2, 590, 561	2, 690, 870	----------	----------	----------	----------	7, 195	
France	----------	64, 221, 367	1, 293, 271	4, 008, 155	2, 007	25, 245	730, 184	25, 930	
Germany	85, 224	148, 665, 920	----------	23, 678, 355	203	----------	22, 429	26, 050	
Hong Kong	----------	5, 717, 568	----------	----------	107	651	1, 536, 748	239, 479	
India, British	----------	1, 306, 346	3, 571, 643	210, 008	4, 984	68, 847	5, 492	167, 572	
Italy	----------	43, 747, 205	----------	2, 639, 365	----------	19, 309	60, 373	668	(2)
Japan	----------	217, 879, 738	----------	3, 804, 560	1, 203	22, 612	242, 551	2, 221	
Mexico	191, 935	2, 038, 091	4, 963	60, 510	179, 865	71, 509	184, 091	576, 758	
Netherlands	197, 956	13, 780, 116	3, 342, 717	3, 292, 728	9, 225	65, 027	7, 526	24, 125	
Norway	----------	1, 381, 680	4, 837, 896	33, 676	6, 524	----------	4, 313	5, 155	
Philippine Islands	8, 357	1, 317, 673	5, 420	----------	50, 183	25, 581	176, 639	2, 550, 160	
Poland and Danzig	----------	24, 912, 966	----------	245, 807	----------	----------	----------	145	
Spain	----------	----------	----------	22, 058	----------	----------	----------	3, 350	
Sweden	----------	37, 250, 260	811, 213	672, 274	2, 141	----------	----------	18, 502	
U. S. S. R	----------	110, 359	----------	----------	557	----------	----------	198	
United Kingdom	335, 530	61, 230, 901	145, 398	533, 366	7, 618	37, 820	7, 211	82, 784	
Other countries	----------	18, 717, 953	10, 442, 040	140, 545	638, 176	531, 450	3, 805, 272	7, 123, 932	
	2, 004, 229	741, 090, 681	29, 356, 264	43, 621, 346	1, 644, 804	1, 099, 590	10, 723, 595	14, 486, 917	(2)
Total value	$171, 878	$74, 062, 534	$3, 127, 467	$3, 574, 504	$355, 368	$224, 466	$1, 285, 951	$3, 317, 680	$689, 008

[1] Changes in table in Minerals Yearbook, 1938, p. 98, are as follows: Bars, ingots and other forms exported to Czechoslovakia should read 11,344,092 pounds; Germany, 75,070,191 pounds; Italy, 41,624,043 pounds; Poland and Danzig, 7,374,538 pounds; total, 590,127,046 pounds; value, $76,684,278.

[2] Figures for quantity not recorded.

Copper [1] exported from the United States, 1934–38

Year	Pounds: Metallic [2]	Pounds: Total	Total value	Year	Pounds: Metallic [2]	Pounds: Total	Total value
1934	592, 718, 891	625, 485, 074	$49, 263, 566	1937	692, 458, 087	700, 633, 621	$92, 774, 770
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				

[1] Exclusive of "Other copper manufactures" valued at $500,974 in 1934, $570,061 in 1935, $585,568 in 1936, $851,697 in 1937, and $689,008 in 1938, 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, 1934–38

Year	Pounds	Value	Year	Pounds	Value
1934	3, 858, 629	$128, 756	1937	23, 528, 240	$1, 212, 430
1935	4, 508, 271	142, 467	1938	31, 249, 735	1, 229, 317
1936	10, 734, 408	342, 847			

Brass and bronze exported from the United States, 1937–38

	1937: Pounds	1937: Value	1938: Pounds	1938: Value
Ingots	478, 311	$70, 755	236, 061	$24, 186
Scrap and old	37, 102, 665	3, 198, 552	31, 976, 834	2, 295, 074
Bars and rods	16, 023, 309	2, 267, 969	2, 311, 072	411, 417
Plates and sheets	871, 415	234, 521	1, 098, 504	242, 206
Pipes and tubes	2, 722, 099	705, 755	1, 385, 065	310, 903
Pipe fittings and valves	2, 697, 113	1, 706, 592	1, 971, 222	1, 256, 571
Plumbers' brass goods	1, 274, 944	679, 384	997, 044	575, 691
Wire of brass or bronze	656, 424	185, 558	367, 305	103, 831
Brass wood screws	(1)	47, 572	(1)	23, 742
Hinges and butts of brass or bronze	(1)	75, 950	(1)	57, 883
Other hardware of brass or bronze	(1)	367, 703	(1)	248, 932
Other brass and bronze manufactures	(1)	1, 926, 576	(1)	2, 394, 411
	-------------	11, 466, 887	-------------	7, 944, 847

[1] Weight not recorded.

Unmanufactured brass exported from the United States, 1934–38

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

Year	Pounds	Value	Year	Pounds	Value
1934	1, 855, 305	$327, 685	1937	17, 373, 035	$2, 573, 245
1935	2, 329, 353	382, 681	1938	3, 645, 637	677, 809
1936	2, 712, 758	462, 535			

SMELTING AND REFINING

One of the present-day trends in reverberatory smelting is definitely toward high-tonnage operations, according to Honeyman.[3] At the Phelps Dodge Corporation Douglas (Ariz.) plant, the reconstructed 107- by 26-foot reverberatory furnaces are operated at the rate of 1,000 tons of solid charge a day. The arch, all of silica brick, is high enough above the bath to give ample combustion space within the furnace.

[3] Honeyman, P. D. I., Metallurgy of Copper: Min. and Met., vol. 20, No. 385, January 1939, p. 19.

At Noranda high tonnages—up to 1,500 tons of solid charge per furnace day—were reported smelted in reverberatories. Use of the suspended magnesite arch continues at this plant. At both the Douglas and United Verde smelters of Phelps Dodge extensive use is being made of C. R. Kuzell's method of hot-patching the inside of silica arches of reverberatories without interfering with furnace operation. The method consists of building up and renewing worn areas in the refractory surfaces by spraying on an aqueous suspension of finely divided particles of refractory material.

The design of the new Nevada Consolidated Copper Corporation smelter at Hurley, N. Mex., is much like that for the company's revamped smelter at McGill, Nev. At McGill the reverberatory is of the wet-charge type, the charge material being distributed along the furnace by vibrating conveyors. Use of the wet charge makes possible virtual elimination of dust, and this practice will be used at Hurley.

According to Boggs,[4] Tennessee Copper Co.'s principal source of revenue is from sulfuric acid and iron; consequently, its copper metallurgy is passing through a slow process of change from the old method of smelting ore directly in blast furnaces to all-milling selective flotation. When the article was written only one small blast furnace was in operation. Boggs said that it was to be replaced in the near future, probably with a coal-fired reverberatory or an electric furnace.

New developments in connection with electric smelting include improved practice in building large electric furnaces of a size more nearly comparable with that of reverberatories. According to Sem,[5] the new methods that have been developed lately for utilization of sulfur dioxide in smelter gases have made it desirable—in many instances necessary—to utilize the gases. The economic possibility, however, depends to a great extent on concentration of sulfur dioxide in the gases. He claims that a high concentration in gas is possible only in an electric smelting furnace where the gas is not diluted with gases of combustion.

Several articles on copper refining, published recently, are of general interest.[6]

WORLD ASPECTS OF COPPER INDUSTRY

International cooperation.—During 1938 the flexibility of the copper-restriction scheme was proved. As the year began, foreign producers who are members of the cartel were operating at 105 percent of their agreed production capacities. These capacities, incidentally, do not represent actual production capacities but are merely bases for the regulation of operating rates. Foreign demand was well maintained throughout the year, and foreign visible refined stocks declined almost steadily, but the reverse of these conditions prevailed in the domestic market. The unsatisfactory situation in the United States and the large exportation of United States copper contributed to the midyear weakness in European price. The cartel took ~~steps to pro-~~ tect the position of the foreign market by reducing output 10 percent,

Incorrect

[4] Boggs, W. B., Copper Metallurgy Improvements Limited: Engineering and Mining Journal, vol. 140, No. 2, February 1939, p. 77.

[5] Sem, M., Electric Smelting With the Westly Furnace: Eng. and Min. Jour., vol. 140, No. 1, January 1939, pp. 47–48.

[6] Clark, C. W., Refining of Copper: Canadian Metals and Metallurgical Ind., vol. 1, No. 4, April 1938, pp. 113–116.

The Mining Journal (London), Copper Refining at Prescott: Vol. 201, No. 5359, May 7, 1938, pp. 452–455.

Engineering and Mining Journal, Rhokana Refines Copper at Nkana: Vol. 140, No. 1, January 1939, pp. 42–43.

or to 95 percent of agreed capacities, effective July 1. Smaller domestic and foreign production and increased consumption marked the third quarter of the year, and by October a tight situation developed regarding foreign supplies, partly or largely caused by war fears. In an evident effort to prevent a run-away market, the foreign group in October, announced two step-ups in production rates—to 105 percent of capacity and to unrestricted production. The largely increased tonnages made available, combined with a reversal of the uptrend of consumption, caused the cartel members to announce resumption of production restriction to 110 percent of capacity, effective January 1, 1939. Before this rate was obtained, it was deemed advisable to cut the output rate to 105 percent for December 15 to 31 and to 100 percent at the beginning of 1939. The rapid changes in cartel rates of activity in the last quarter of 1938 would seem to indicate that the group is more interested than formerly in short-time trends.

The following table, published in the annual review of Brandeis, Goldschmidt & Co., Ltd., for 1938, shows clearly the spread between capacities agreed upon for calculating production quotas and estimated full capacities.

Calculated basic production capacities, highest monthly outputs, and estimated full capacities of the chief properties operating under the restriction scheme, in long tons

Producer	Agreed capacity at 100 percent	Highest monthly output	Estimated full capacity
Chile Copper Co.	145,000	19,000	220,000
Andes Copper Co.	30,000	7,000	100,000
Braden Copper Co.	117,000	13,000	160,000
Rhodesian producers	202,000	19,000	280,000
Katanga	112,000	17,000	200,000
	606,000	75,000	960,000

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 and is followed in importance by Chile, Germany, Canada, Great Britain, and Belgium.

World smelter production of copper fell 14 percent below the high record of 1937 but, except for that year, was the highest ever attained. As the output from domestic materials at plants in the United States was about one-third below 1937, the high level of world production in 1938 is explained by nearly record operations abroad. Of the important copper-producing countries Canada and Northern Rhodesia produced more copper than ever before; but output in Northern Rhodesia, at least, lagged considerably behind capacity operations. Chile's smelter production decreased 15 percent, but mine output only 10 percent. Belgian Congo's smelter total was 18 percent below 1937. The below-capacity production in Northern Rhodesia and the drop in Chile and Belgian Congo were due to restricted activity agreed on by cartel members. The strenuous efforts of countries like Germany, U. S. S. R., and Japan to become more nearly self-sufficient in supplies of copper made little headway in 1938. Output in U. S. S. R. increased; eventually this country will supply all of its own needs and have an exportable surplus of metal, but its program lags behind Government plans, and a large import balance continues.

World mine and smelter production of copper, 1936–38, in metric tons

[Compiled by M. T. Latus]

	Mine			Smelter		
	1936	1937	1938	1936	1937	1938
North America:						
Canada	190,974	240,416	265,813	[1] 173,412	[1] 210,024	[1] 222,730
Cuba	11,163	13,191	14,431	-----	-----	-----
Mexico	29,713	46,077	41,851	32,623	45,755	41,425
Newfoundland	5,336	8,463	8,056	-----	-----	-----
Panama	22	3	-----	-----	-----	-----
United States	557,566	763,844	505,991	[2] 592,645	[2] 820,333	[2] 570,773
	794,774	1,071,994	836,142	798,680	1,076,112	834,928
South America:						
Bolivia	[3] 3,249	[3] 3,699	[3] 2,885	-----	-----	-----
Chile	256,209	413,010	371,370	244,699	396,461	337,508
Peru	33,352	36,649	37,750	32,768	35,439	35,969
	292,810	453,358	412,005	277,467	431,900	373,477
Europe:						
Belgium	-----	-----	-----	[4] 58,770	[4] 90,260	(5)
Bulgaria	2	16	64	-----	-----	-----
Czechoslovakia	(5)	(5)	(5)	1,103	2,013	(5)
Finland	11,391	12,032	12,232	6,636	10,545	11,824
France	531	591	[6] 600	1,099	(5)	(5)
Germany	26,906	27,129	(5)	[7] 61,600	[7] 65,500	[7] 70,000
Austria	12	12	(5)	1,800	2,071	
Greece	-----	300	(5)	-----	-----	-----
Hungary	116	1,216	(5)	-----	-----	-----
Italy	603	610	(5)	469	1,465	2,933
Norway	22,607	20,075	(5)	8,365	8,302	(5)
Portugal	[6] 2,000	[6] 2,000	[6] 2,000	-----	-----	-----
Rumania	[8] 645	[8] 1,361	(5)	645	1,361	(5)
Spain	[6] 30,000	[6] 28,000	[6] 30,000	[6] 10,100	[6] 10,200	[6] 12,000
Sweden	8,103	7,174	(5)	9,547	9,093	(5)
U. S. S. R.[9]	[10] 82,999	[10] 94,250	[10] 114,552	82,999	94,250	114,552
United Kingdom	63	37	(5)	9,499	7,519	(5)
Yugoslavia	39,600	42,300	49,500	39,400	39,410	41,993
	226,000	237,000	(5)	292,032	342,000	(5)
Asia:						
Burma	4,100	3,800	(5)	-----	-----	(5)
China [11]	-----	(12)	240	-----	(12)	240
Cyprus	16,613	27,461	29,780	-----	-----	-----
Federated Malay States	21	-----	-----	-----	-----	-----
India, British	9,043	11,177	(5)	7,316	6,940	5,416
Japan:						
Japan Proper	[10] 77,973	[10] 87,600	(5)	77,973	87,600	(5)
Chosen	[10] 3,637	[10] 5,122	(5)	3,637	5,122	(5)
Taiwan	[6] 4,000	(5)	(5)	-----	-----	-----
Turkey	(5)	[10] 400	(5)	(5)	400	(5)
U. S. S. R.	(9)	(9)	(9)	(9)	(9)	(9)
	[9] 115,387	[9] 136,000	(5)	[9] 88,926	[9] 100,062	(9)
Africa:						
Algeria	-----	-----	22	-----	-----	-----
Belgian Congo	[10] 95,667	[10] 150,588	[10] 124,000	95,667	150,588	124,000
Rhodesia:						
Northern	173,468	249,835	(5)	144,617	211,513	216,450
Southern	10	-----	-----	-----	-----	-----
Union of South Africa	9,068	11,389	11,315	8,559	13,302	10,570
	278,213	411,812	(5)	248,843	375,403	351,020
Oceania: Australia	18,859	19,434	19,305	13,527	17,679	(5)
	1,726,043	2,329,598	(5)	1,719,475	2,343,156	[13] 2,021,000

[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: 1936, 554,659 tons; 1937, 757,188 tons; 1938, 510,133 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 1937 contributed about 90 percent of the total world output.

World consumption.—World consumption of copper in 1938 declined 10 percent from the high record established in 1937; it exceeded that in any other year except 1937, however, according to figures of the American Bureau of Metal Statistics. The lower total may be ascribed to the 41-percent drop in United States consumption, because the use of copper abroad reached a new high level in 1938. By an examination of world consumption figures it is almost possible to ascertain the countries where disturbed political conditions existed or where war was either under way or anticipated. These data show that apparent consumption rose 42 percent in Austria, 48 percent in Germany, 51 percent in Poland, and 10 percent in Japan over totals for 1937. The consumption figures for these countries are more impressive if compared with 1934, showing gains of 178, 53, 142, and 78 percent, respectively. In comparison with 1934 consumption in U. S. S. R. increased 197 percent and in Czechoslovakia 79 percent, although they gained only 5 percent each in 1938. It is interesting to note that consumption rates in France and the United Kingdom declined 9 and 15 percent, respectively, from 1937 but increased 20 and 17 percent over 1934. Consumption in the United Kingdom, however, was at record-breaking levels in 1937. All foregoing figures are undoubtedly exaggerated for any one year. Surely Germany and Japan cannot have consumed all of the metal made available by production and importation in recent years. Possibly the statistics can be taken to indicate that the United Kingdom acquired a more nearly adequate stock pile of metal in advance of Germany and Japan and that much of the copper credited as consumption in those two countries in 1937 and 1938 went into inventories.

REVIEW BY COUNTRIES

Belgian Congo.—Production of copper in Belgian Congo amounted to about 124,000 metric tons in 1938 compared with 150,588 tons in 1937.

According to an item in the South African Mining and Engineering Journal of December 31, 1938, Prof. Maurice Robert, director of the Geological Service of the Katanga Special Committee, in a report to the Belgian Colonial Institute (Brussels) anticipated that important mining discoveries could still be made and that these discoveries will be made mostly underground. They certainly will be more difficult to work and may have an inferior yield, but their probable existence should extend the life of Katanga as a mining country far longer than is expected at present. Late in 1938 employees at Union Minière du Haut Katanga were estimated to total nearly 1,000 Europeans and about 13,000 natives.

Press reports indicate that copper discoveries in depth by Union Minière in the west are so considerable that they are likely to occupy the main part of company activities in the future and to necessitate transfer of its major operations from Kipushi-Elisabethville-Jadotville to the Kolwezi, where a concentration plant will be erected.

Canada.—Production of copper in Canada continued to establish new records in 1938, with a mine total of 293,010 short tons compared with 265,014 in 1937. Smelter production also reached a new high rate, totaling 245,519 tons compared with 231,513 in 1937. Of the total mine production 55 percent came from Ontario where the output is entirely from the nickel-copper ores of the Sudbury district. The International Nickel Co. of Canada, Ltd., is the principal producer in this district, whose production of copper is determined by the output of nickel. Operations at the refinery were uniform throughout the year and substantially at present capacity. The Copper Cliff smelter produced 182,904 tons of bessemer matte and 158,912 tons of converter copper. The Ontario Refining Co. Ltd., subsidiary of International Nickel, received 158,793 tons of converter copper in the molten state from the Copper Cliff smelter and produced 145,141 tons of refined copper. Quebec supplied 19 percent of the total, with production principally from Noranda Mines, Ltd. Noranda blister is shipped to the Canadian Copper Refiners, Ltd., at Montreal East. The outstanding achievement of the year was reported to be the discovery at considerable depth of a new ore body in the Amulet section of Waite-Amulet Mines, Ltd., controlled by Noranda, and plans are being made for its development. Noranda smelts the product of Waite-Amulet and Normetal, but Aldermac exports its concentrates. The Consolidated Copper & Sulphur Co., Ltd., operated continuously and exported copper and pyrites concentrates.

The Flin Flon and Sherritt Gordon mines produced the output accredited to Manitoba and Saskatchewan. These mines ship their ores to the Hudson Bay Mining & Smelting Co., Ltd., for smelting. Output in Manitoba increased from 22,460 tons in 1937 to 32,791 in 1938 while that in Saskatchewan dropped from 11,218 to 9,078 tons.

British Columbia production increased from 22,899 short tons in 1937 to 32,571 in 1938 because the mine of Granby Consolidated, reopened in May 1937, produced steadily throughout 1938. The Britannia mine on Howe Sound produced at about the same rate as in 1937. Granby's entire production is being shipped to Japan, and Japanese interests are reported also to have reopened the old Tidewater copper mine on the west coast of Vancouver Island. Copper mining at Britannia Beach was described by Huttl.[7]

The following table shows the production of copper, by Provinces.

Copper produced (mine output) in Canada, 1937–38, by Provinces, in pounds

Province	1937	1938	Province	1937	1938
British Columbia	45,797,988	65,141,290	Quebec	94,653,132	112,645,797
Manitoba	44,920,835	65,582,772	Saskatchewan	22,436,843	18,156,157
Nova Scotia	180,609				
Ontario	322,039,208	324,494,386		530,028,615	586,020,402

Canada exports most of its copper and in 1938 shipped 54,903 tons of copper in ore, matte, regulus, etc.; 15,264 tons of blister; 181,764 tons of ingots, bars, etc.; 26,756 tons of rods, strips, etc.; and 1,719 tons of old and scrap copper to foreign countries. Of the ore exported 29,257 tons went to the United States and 15,168 tons to Japan. The United Kingdom was the destination of 108,263 tons of the refined ingots and bars exported.

[7] Huttl, John B., Producing Copper at Britannia Beach, B. C.: Eng. and Min. Jour., July 1938, vol. 139, No. 7, pp. 29–35.

Chile.—In 1938 production of copper in Chile amounted to 337,508 metric tons, a decline of 15 percent from the record output of 1937 yet with the exception of that year the highest on record. Mine production totaled 371,370 tons compared with 413,010 in 1937. Copper is a very important source of revenue to the Government of Chile, and plans were being formulated early in 1939 for obtaining additional funds from this industry. A proposal approved by the Chamber of Deputies included a progressive tax on exports—exempting copper below 6 cents (American currency) a pound—of 10 percent on the difference between 6 and 10 cents, 20 percent on the difference between 6 cents and prices above 10 cents and as much as 15 cents, and 30 percent on the difference between 6 cents and amounts above 15 cents a pound. The Chilean Senate, on the contrary, approved a 10-percent tax on copper producers' profits as a substitute. No final decision had been reached by May 1939.

The Instituto de Fomento Minero è Industrial de Antofagasta announced on May 8, 1938, that it had been authorized by the Caja de Credito Minero to purchase low-grade copper ores at 230 Chilean pesos instead of 139, Caja's previous price. It is said the Caja will not realize any profit by paying this higher price but hopes to stimulate the small mining industry of Antofagasta and other Provinces of Northern Chile thereby. It will make available to small miners, at cost, explosives and other materials necessary to the mining of low-grade copper ores.

The Chile Copper Co. produced 148,100 metric tons of copper in 1938 compared with 181,800 in 1937, and Andes Copper 55,200 tons compared with 54,900. These two companies are subsidiaries of Anaconda Copper Mining Co. Braden Copper Co. (subsidiary of Kennecott Copper Corporation) produced 119,800 tons of copper, second only to the record output of 144,300 tons in 1937. During 1938, 7,075,042 short (6,418,337 metric) tons, assaying 2.22 percent copper, were treated. Improvements in metallurgy at the mill resulted in the production of concentrates that averaged 33.08 percent copper compared with about 26 percent before the concentrate grinding and re-treatment plant was placed in operation in 1937. A strike lasting 11 days occurred in July and was amicably settled. The history, geology, mining methods, and safety program of the Braden mine were discussed in an article published in 1938.[8]

Most of the copper produced in Chile is sold for consumption in other countries. Exports of electrolytic copper totaled 184,200 metric tons in 1938 compared with 186,060 in 1937. Of the 1938 total 75,621 tons were shipped to Great Britain, 48,449 to Belgium, 16,919 to Sweden, 16,535 to France, and 12,808 to Italy. Blister exports totaled 165,120 tons in 1938 compared with 197,189 tons in 1937. The United States was the principal destination of the exports of blister in 1938, 56,532 tons going to that country while 50,651 went to Great Britain, 17,786 to Switzerland, 16,105 to Italy, and 10,692 to France. Exports of ore and concentrates fell from 22,707 tons in 1937 to 6,088 in 1938.

Cyprus.—Production of copper in Cyprus has increased in recent years. Exports of concentrates totaled 146,550 long tons, estimated

[8] Boletin Minero de la Sociedad Nacional de Mineria, La Braden Copper Co.: Vol. 54, April 1938, pp. 309-315.

to contain 20 percent copper in 1938 compared with 111,506 tons in 1937 and 58,714 in 1936. Germany received 141,481 metric (139,000 long) tons from Cyprus in 1938 compared with 79,710 (78,500) in 1937.

Czechoslovakia.—Demand for copper in Czechoslovakia continued at record-breaking levels and established a new-high record in 1938. This condition was brought about by the disturbed relations with Germany and other neighboring countries, which resulted in Czechoslovakia's annexation by Germany in March 1939. Imports of refined copper and of copper cakes totaled 26,322 metric tons in the first 8 months of 1938 compared with 32,854 tons for the year 1937. Exports were 1,404 and 2,388 tons, respectively. It is reported that the Krompach Copper Works in Slovakia produced 1,000 metric tons of raw copper in 1938 and hoped to treble this production in 1939. An electrolytic refinery is being installed.

Finland.—A detailed account of the mining, milling, and smelting methods employed by the Outokumpu Copper Co. and other information on copper production in Finland are given in an article by the general manager published in Mining and Metallurgy for February 1938 and summarized in the Bulletin of the Imperial Institute (London) for April–June 1938. The company is reported to have decided to construct a copper refinery in Imatra and a copper rolling mill near Pori in Bjorneborg where power supplies soon will be available.

Germany.—Figures covering mine output of copper in Germany are not available. Those for smelter production in 1938 differed little from those for 1937, showing a small increase. Germany's efforts to become more nearly self-sufficient with regard to its needs for copper, by increasing domestic mining and by curtailing the use of copper wherever substitution could be practiced, failed to make noticeable progress in 1938, when imports of different classes of copper-bearing materials again gained substantially. Imports of copper ores, including cupreous pyrites, totaled 653,931 metric tons compared with 555,578 in 1937 and 482,471 in 1936. It is noteworthy that Cyprus supplied 141,481 tons of the total compared with 79,710 in 1937. Copper imported in ingots, bars, etc., totaled 272,400 tons, of which 76,500 tons were credited to Rhodesia, 62,330 to the United States, 40,007 to Chile, and 39,931 to Belgian Congo. Imports of this class amounted to 169,920 tons in 1937 and 127,549 in 1936. Copper-scrap imports totaled 27,308 tons in 1938 and 32,703 in 1937. Germany exported 5,625 tons of ore, 355 tons of bars, etc., 17,689 tons of rods, sheets, etc., and 4,523 tons of wire in 1938. So much copper has entered Germany in the past several years that it seems almost certain that a stock pile of significant proportions has been accumulated. According to an editorial in the American Metal Market of March 23, 1939, it probably aggregates 200,000 or more tons. Germany's apparent consumption of copper totaled 339,000 metric tons in 1938, 228,300 in 1937, and 185,300 in 1936. These data are calculated in the conventional way on the assumption that metal made available was consumed. Any accumulation of stocks would reduce these figures on consumption.

Japan.—Publication of official statistics for Japan was prohibited subsequent to July 31, 1937. Available data, however, indicate that the consumption of copper in this country in 1938 surpassed the high record for 1937. Exports of refined copper from the United States increased from 73,000 short (66,000 metric) tons in 1937 to 109,000 short (99,000 metric) tons in 1938. Exports of copper in ore, matte, etc., from Canada to Japan rose from 2,842 short (2,578 metric) tons in 1937 to 15,168 short (13,760 metric) in 1938. According to Brandeis Goldschmidt & Co., Ltd., Japan probably consumed 240,000 long (244,000 metric) tons in 1938 compared with their estimates of 190,000 long (193,000 metric) tons for 1937 and 125,000 long (127,000 metric) tons for 1936. Their estimate for 1938 was made on the assumption of an increase in mine production to 90,000 long (91,000 metric) tons, on a 30,000-ton increase in exports from the United States, and on anticipated increases in receipts of ores and other cupreous materials from Canada, South America, and the Far East. The quantity of stocks accumulated by the Government from the additional tonnages made available during the year cannot be surmised, but it is unreasonable to assume that Japan has used all of the copper acquired in 1937 and 1938. In the middle of 1938 industry was reported to be poorly supplied.

Northern Rhodesia.—Smelter output of copper in Northern Rhodesia established a new high record in 1938 with a total of 216,450 metric (213,000 long) tons compared with 211,513 (208,000) in 1937, the previous record year. Although production was a record-breaking rate in 1938 because of agreed restrictions thereon it remained considerably below actual capacity.

Roan Antelope Copper Mines, Ltd., hoisted 3,126,100 short (2,791,161 long) tons of ore during the fiscal year ended June 30, 1938, from which 75,253 long tons of blister copper were produced. In the year immediately preceding 2,880,300 short (2,571,700 long) tons of ore and 69,560 long tons of blister were produced. The average cost was £22.151 per long ton of blister in 1938 compared with £21.880 in 1937. Ore reserves were estimated to be 87,498,099 short tons of ore containing 3.43 percent copper compared with 91,769,128 tons at the end of June 1937. Substantial additions to reserves are expected to result with the opening of ground in the Roan Antelope Extension not included in the original ore-reserve calculation. The company estimated that about £750,000 further expenditure would be required in the fiscal year ending June 1939 to complete the Western extension program and various plant enlargements that will raise the monthly output capacity to 10,000 short tons of copper.

The Rhokana Corporation, Ltd., produced 44,247 long (49,557 short) tons of blister copper and 32,028 (35,871) tons of electrolytic copper, a total of 76,275 (85,428) tons, in the fiscal year ended June 30, 1938, which differed little from the total of 75,254 (84,284) tons for the year immediately preceding. The average cost of blister production was £22 7s. 5d. and of electrolytic copper £24 4s. 3d. As a result of new arrangements the production quota for Rhokana was increased 952 short tons of copper a month, subject to the same percentage increases and decreases as the previous basic quota of 6,338 short tons. In the Nkana section 1,964,900 short tons and in the Mindola section 836,600 short tons were hoisted. A total of 2,796,500 short tons were concentrated during the year compared with 2,651,200 short tons in the fiscal year ended June 30, 1937. The company sold 1,662,771 pounds of cobalt (in alloy and refined products) during the year. It has erected a plant for differential flotation of copper and cobalt ores (designed to produce a rich cobalt concentrate) and added a third electric furnace to its cobalt plant. The Nkana copper refinery was described by Wheeler and Eagle.[9] The establishment is a modern furnace and electrolytic plant designed for refining blister copper high in bismuth. This article is briefed in the January (1939) issue of Engineering and Mining Journal. Ore reserves at the end of June 1938 were reported as follows: Nkana North Ore Body, 24,398,056 short tons containing 3.51 percent copper; Mindola Ore Body, 78,378,616 tons containing 3.54 percent; and Nkana South Ore Body, 15,181,000 tons containing 2.79 percent—a total of 117,957,672 tons averaging 3.44 percent copper. Rhokana owns a 32.303-percent interest in Mufulira Copper Mines, Ltd.

Production of copper by the Mufulira Copper Mines, Ltd., was greatly increased in the fiscal year ended June 30, 1938. Ore extracted totaled 1,598,886 short tons containing 4.53 percent copper, ore milled amounted to 1,585,000 short tons, and blister copper was 52,436 long (58,728 short) tons. In the fiscal year ended June 1937 the output of blister copper was 37,230 long (41,698 short) tons. The company's basic quota is 4,811 long (5,388 short) tons of copper a month. During major reverberatory-furnace and waste-heat-boiler repairs in May 5,475 short tons of concentrates were shipped to the Roan Antelope smelter, and 2,573 long (2,882 short) tons of blister copper were produced for Mufulira. Additions to the smelter, to insure uninterrupted operation, were begun and include among other things a second reverberatory furnace, a second 60,000-pound waste-heat boiler, extensions to the converter aisle in both directions, a third 13- by 30-foot converter, and a 13- by 30-foot holding furnace with a second casting machine. Ore reserves comprised 110,499,000 short tons of 4.38-percent copper at Mufulira, 25,000,000 tons of 3.46-percent copper at Chambishi, and 21,000,000 tons of 3.47-percent copper at Baluba, a total of 156,499,000 tons averaging 4.11 percent copper.

Peru.—In 1938 the Cerro de Pasco Copper Corporation produced 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. Production of this company in 1937 amounted to 75,094,065 pounds (34,062 metric tons) of copper, 9,881,827 ounces of silver, 51,455 ounces of gold, 42,005,290 pounds of lead, and 22,946 short tons of zinc concentrates. The corporation is reported to be developing a copper prospect at Ayuricocha, Peru, where 400,000 tons of ore averaging 9 percent copper have been developed.

Turkey.—An article in the Engineering and Mining Journal[10] describes conditions regarding copper in Turkey as follows:

> To place the copper mines, which have long remained inactive, again in operation constitutes one of the basic objectives of the Government economic program. The systematic work undertaken should soon show results. In fact, the Ergani mine has already begun producing Standard copper in 1939. The annual production of the company will be 12,000 tons.
>
> Eti Bank has also taken the necessary steps to work the Mourgoul mine, in the Province of Artvin. Plans have been prepared and construction of the plant,

[9] Wheeler, A. E., and Eagle, H. Y., Nkana Copper Refinery of Rhokana Corporation, Ltd.: Trans. Electrochem. Soc., vol. 74, 1938, Preprint 19, 24 pp.

[10] Engineering and Mining Journal, Fifteen Years of Mining in the Turkish Republic: Vol. 140, No. 5, May 1939, p. 34.

which will be larger than that of the Ergani mine, has begun. The mine's annual capacity will be approximately 12,000 to 15,000 tons.

The Kuvarshan copper mine, in the Province of Artvin, has been in operation for 2 years. After the foreign company, which had been working it, suspended its activities due to the crisis, the Government decided to put it in operation. The Eti Bank, which took possession of it, immediately completed the plant, with the result that the Kuvarshan is now in the exports list. Its annual capacity is about 2,000 tons. In 6 months of 1938 it exported 799 tons, against 200 in the corresponding period of 1937. At this pace, the exportation of copper from the Kuvarshan mines is expected to increase rapidly.

U. S. S. R.—Smelter production of copper in the U. S. S. R. increased from 94,250 metric tons in 1937 to 114,552 in 1938 but still lagged far behind Government plans. These called for an output of 135,000 to 145,000 tons in 1937 and for a much larger tonnage in 1938, looking forward to self-sufficiency and an eventual large exportable surplus of copper. Imports of metal during the first 9 months of 1938, however, totaled 49,500 metric tons, the same monthly rate as in1937 and substantially above the monthly rates in earlier recent years. The copper industry in the U. S. S. R. is described in the Bulletin of the Imperial Institute [11] which states that copper reserves of the U. S. S. R. total over 17,000,000 tons of metal. It says furthermore that the most extensive deposits are in Kazakstan, the two main groups being the Kounrad ores near Karsakpai and the Balkhash ores near the northern shore of Lake Balkhash. The Urals also contain considerable deposits of copper ore, and there are other deposits in Uzbekistan, Bashkiria, Middle Volga, West Siberia, Transcaucasia, Leningrad Province, and the Kola Peninsula. The large increase in demand for copper in the U. S. S. R. is due to rearmament, electrification, and rapid industrial development, which have advanced at a greater rate than production, resulting in the large importation already noted. In recent years operations of the copper industry have been changing from small- to large-scale status. The article says:

Construction of the new works seems to be proceeding very slowly, and some of the "giants" projected some years ago still exist only on paper. A big step toward increased production has been taken by the linking up of two of the main producing areas, the Karsakpai and Balkhash deposits, by rail with Karaganda.

The more important new works, under construction or projected, are:

(1) The Balkhash plant. Construction of this plant was begun in 1930, and although 300 million rubles have been spent on construction and equipment no copper has yet been produced. The first section of the plant is designed to produce 35,000 tons of black copper per annum, and the total eventual output is to be 100,000 tons per annum. It was planned to produce about 12,000 tons in 1937, but as recently as December 10 it was announced that the first section of the concentration plant was only then about to be put into operation.

(2) The Jezkazgan plant at Karsakpai in Kazakstan. This plant, which will work on low-grade ores (metallic content about 1.6 percent), is designed to produce eventually 200,000 tons of black copper per annum. It will be three or four years, however, before production is even begun.

(3) Sreduralmedstroi, the Mid-Ural copper plant. The first section of the concentration plant, treating 2,400 tons of ore a day, was completed early in 1937. The eventual capacity of the concentration plant is 14,000 tons of ore a day, and of the plant as a whole 50,000 tons of copper a year.

(4) Bliava in the Middle Volga region. This plant was expected to start operations in 1937 and to produce up to 5,000 tons of copper in that year. So far as is known it is not yet completed. Its eventual output capacity is stated to be 35,000 tons. It is also proposed at this plant to produce sulphur by the Norwegian patented "Orkla" process.

[11] Imperial Institute (London), The Copper Industry of the U. S. S. R.: Bull., vol. 36, No. 1, January-March 1938, pp. 52-60.

(5) A nickel-copper plant under construction at Monchegorsk in the Kola Peninsula.

(6) A projected plant to produce 100,000 tons of copper a year on the Central Asian ore deposits near Tashkent.

It will thus be seen that, adding present production of copper to the scheduled output of works under construction or proposed to be constructed in the next few years, the Soviet Union is planning for an eventual output, say within the next ten years, of about 500,000 tons of copper per annum.

Electrolytic copper is produced at present at the Ural works of Pishmin and Kishtin, the former having a potential output capacity of 100,000 tons per annum.

Methods of reducing concentrating and smelting losses are being studied, as it admitted, apparently, that plant efficiency is not satisfactory. Russian Economic Notes [12] state that, of the amount scheduled for capital investment, funds assigned for nonferrous metals recovery will be used chiefly to complete three copper refineries (the Pribalkhash, Central Ural, and Bliava), two nickel combines, and two aluminum plants. The first section of the Balkhash plant, designed for an annual output of 50,000 tons of copper, was put into operation late in 1938. It is reported that this plant is to be enlarged so that it will have a capacity of 100,000 tons by 1942.

Yugoslavia.—Mine output of copper in Yugoslavia advanced from 42,300 metric tons in 1937 to 49,500 in 1938. The Mines de Bor, operated under French control, reported the production of 41,992 tons of copper in 1938 compared with 39,410 in 1937. An electrolytic refinery was completed and opened on July 2. At the end of the year production at this plant was reported to be at the rate of 1,000 tons a month. Exports of crude copper began to fall when the new refinery was assured. Imports into the United States of unrefined copper from Yugoslavia declined from 17,300 tons in 1936 to 14,600 in 1937 and 9,600 in 1938.

[12] Bureau of Foreign and Domestic Commerce, Russian Economic Notes: No. 369, July 15, 1938.

LEAD[1]

By E. W. PEHRSON AND H. M. MEYER

SUMMARY OUTLINE

The lead industry in the United States was affected adversely in 1938 by the decline in industrial activity at home and the tendency toward overproduction in the foreign market. Domestic production of refined primary lead decreased 25 percent and domestic shipments 27 percent from 1937. Production from foreign ores and base bullion more than doubled. Imports of crude materials and exports of finished lead products also increased. During the first 5 months of 1938 production exceeded demand, and stocks rose steadily. However, in the second half of the year curtailment of domestic output and improvement in demand caused a sharp reduction in producers' stocks of refined metal to the lowest year-end inventory since 1930. Prices dropped from 4.75 cents per pound at New York on January 1 to a low of 4.00 cents in May and June, rose to 5.10 cents in September to November, and declined to 4.85 cents at the close of the year. The average was 4.74 cents compared with 6.01 cents in 1937. Domestic quotations exceeded London prices by 1.41 cents in 1938 and 0.86 cent in 1937. During the latter half of 1938 weakness in the London market retarded price improvement in the United States.

[1] This report deals primarily with the smelting, refining, and consuming phase 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 1934–38, in short tons

	1925–29 (average)	1934	1935	1936	1937	1938
Production of refined primary lead:						
From domestic ores	660,525	299,841	310,505	387,698	443,142	331,964
From foreign ores and base bullion	123,104	11,395	14,055	11,458	24,175	51,705
	783,629	311,236	324,560	399,156	467,317	383,669
Recovery of secondary lead:						
As pig lead	126,600	124,500	156,800	137,500	154,500	119,400
In alloys	153,400	83,900	113,600	125,400	120,600	105,500
	280,000	208,400	270,400	262,900	275,100	224,900
Total production of pig lead (primary and secondary)	910,229	436,736	481,360	536,656	621,817	503,069
Imports: [1]						
Lead in base bullion	95,747	2,450	2,692	312	1,800	15,296
Lead in ore	40,096	10,611	20,025	20,713	34,103	45,370
Exports of refined pig lead	98,048	5,909	6,982	18,313	20,091	45,866
Refined primary lead available for consumption	690,916	305,610	318,900	383,433	[2] 449,464	339,708
Estimated consumption of primary and secondary lead	900,250	488,000	538,900	633,550	678,700	546,000
Prices:						
New York:						
Average for year cents per pound	7.47	3.86	4.06	4.71	6.01	4.74
Quotation at end of year do	6.25	3.70	4.50	6.03	4.75	4.85
London average do	5.87	2.46	3.12	3.91	5.15	3.33
Mine production of recoverable lead	664,230	287,339	331,103	372,919	464,892	369,726
World smelter production of lead	1,850,000	1,465,000	1,523,000	1,628,000	1,858,000	1,791,000

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

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

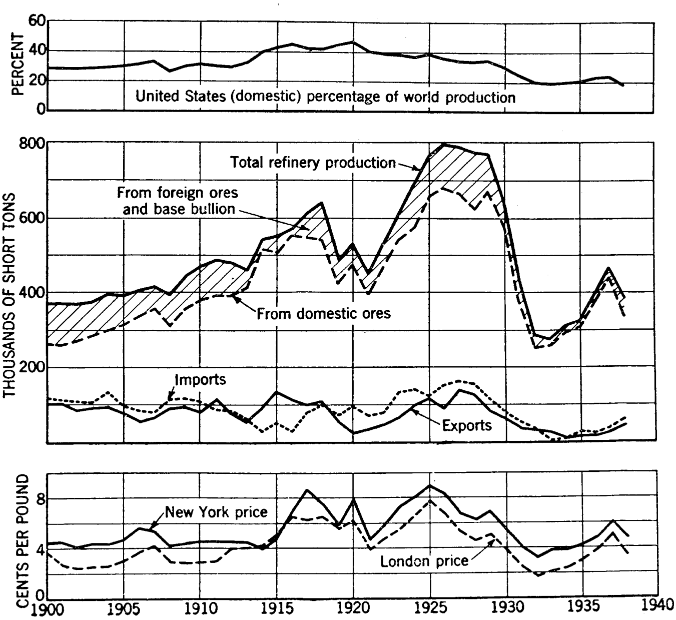

FIGURE 1.—Trends in the lead industry in the United States, 1900–1938. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap and lead exported in manufactures with benefit of draw-back.

Outside the United States smelter production and consumption again attained new peaks and continued the steady increase that has persisted since 1932. Recovery abroad thus has far surpassed that in the United States. Foreign production in 1938 increased 12 percent compared with 1929, whereas that of the United States decreased 48 percent. Similarly foreign consumption increased 24 percent, whereas domestic demand declined 45 percent. All the more important foreign producers except Mexico, Belgium, and Tunisia increased their smelter outputs in 1938 over 1937. However, Mexico recorded a substantial rise in mine production. Apparent consumption in the United Kingdom, Germany, and Italy was higher in 1938 than in 1937, but that in France, Japan, Belgium, and U. S. S. R. was lower.

An event of unusual significance was the formation of the Lead Producers Association in September 1938. The organization includes most of the important producers outside the United States, and its announced purpose is to balance production with consumption. This action was prompted by the depressed prices on the London market, which reached extremely low levels in June. Effective November 1, 1938, a 10-percent reduction in output was agreed upon, with further curtailment if the market failed to improve.

Trade agreements with the United Kingdom and Canada.—As reported in Minerals Yearbook, 1938, the official announcements of the Secretary of State declared that the following lead products would be considered in negotiating a trade agreement with the United Kingdom: Litharge, red lead, suboxide of lead, lead-bearing ores, flue dusts, mattes of all kinds, and miscellaneous commodities. In the Canadian discussions lead ores, etc., as well as lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, and alloys or combinations of lead "not specially provided for" were to be considered. At public hearings begun early in 1938 the lead industry filed briefs protesting any reductions in its protective tariffs. The final treaties were signed on November 17, 1938.

No concessions were made in either treaty on metallic lead or lead-bearing ores, scrap, etc. However, in the agreement with the United Kingdom the import duty on litharge was reduced, effective January 1, 1939, from 2.50 to 2.25 cents per pound, that on red lead from 2.75 to 2.25 cents per pound, and that on lead pigments "not specially provided for" (except suboxide of lead) from 30 percent ad valorem to 20 percent. Other reductions were made on bottle caps, collapsible tubes, and lead manufactures n. s. p. f.

The reciprocal-trade-treaty program thus far has reduced the import duty on several lead products, but no change has been made as yet in the lead industry's basic tariff protection on ores and metal. Zinc producers, however, have not fared so well. In the Canadian Trade Agreement the import duty on zinc ores and slab zinc was reduced 20 percent. An analysis of this cut is presented in the chapter on Zinc.

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 1934 to 1938:

Total pig lead produced in the United States, 1934–38, in short tons

Year	From domestic ores and base bullion	From foreign ores and base bullion	From secondary materials	Total
1934	299,841	11,395	124,500	435,736
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

PRIMARY LEAD

Refinery production.—Production of refined primary lead in 1938 decreased 18 percent and was only 49 percent of the 1925–29 average. Production from domestic ores decreased 25 percent in 1938, whereas that from foreign ores and base bullion increased 114 percent. Production from foreign materials was the largest since 1931 but represented only 51 percent of the 1929 output.

Refined primary lead produced in the United States, 1934–38

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						
1934	186,468	22,744	102,024	311,236	299,841	10,241	1,154	$0.037	$23,031,000
1935	192,544	35,233	96,783	324,560	310,505	13,659	396	.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

[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 1938, 87 percent was derived from domestic ores and 13 percent from foreign ores and base bullion. Production from foreign ores increased 40 percent in 1938 and was the highest since 1930. Refining of foreign bullion was resumed on a large scale in 1938, chiefly because of the closing of one of the Mexican refineries during the latter part of the year, which diverted bullion to domestic plants. 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, 1934–38, by sources, in short tons

Source	1934	1935	1936	1937	1938
Domestic ore	299,841	310,505	387,698	443,142	331,964
Foreign ore:					
Australia	115		172	3,088	7,320
Canada	2,514	1,039	2,277	5,343	3,562
Europe	45	1,086	1,133	388	14
Mexico	1,011	5,809	1,486	3,836	9,745
South America	4,028	2,872	3,883	8,497	9,887
Other foreign	2,528	2,853	2,450	2,241	2,334
	10,241	13,659	11,401	23,393	32,862
Foreign base bullion:					
Mexico	703	396	57	782	18,268
South America	451				
Other foreign					575
	1,154	396	57	782	18,843
Total foreign	11,395	14,055	11,458	24,175	51,705
Grand total	311,236	324,560	399,156	467,317	383,669

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 operate on scrap materials exclusively. Production data from such plants are summarized in the chapter in this volume on Secondary Metals—Nonferrous. 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:

Antimonial lead produced at primary lead refineries, 1934–38

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1934	16,607	2,363	13.6	5,901	330	8,113	14,344
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

SECONDARY LEAD

Recovery of secondary lead decreased 18 percent in 1938. Return of battery scrap for smelting and refining declined in 1938, and stocks at scrap-consuming plants were considerably higher at the end of the year than at the beginning. As the output of domestic refined primary lead dropped 25 percent, the ratio of secondary to primary lead production increased from 62 to 68 percent. Additional details on production of secondary lead in 1938 are given in the chapter in this volume 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 1938 contained 174,853 tons of lead, a decrease of 21 percent from 1937. Of this total, 162,828 tons were derived from refined pig lead; white lead comprised 46 percent, litharge 37 percent, red lead 16 percent, and sublimed lead and orange mineral 1 percent. Sublimed lead and leaded zinc oxide are the principal pigments in which the lead content is derived from ores.

Lead in pigments,[1] 1934–38, by sources, in short tons

Year	Lead in pigments from—			
	Domestic ore [2]	Metal	Scrap	Total
1934	7,538	157,294	379	165,211
1935	12,109	185,151	144	197,404
1936	15,062	204,997	37	220,096
1937	17,363	204,961	127	222,451
1938	12,025	162,828	--------	174,853

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

MINE PRODUCTION

Production of lead from domestic mines in 1938 decreased 21 percent from 1937, returning to the 1936 level. All three major producing regions shared the lower rate, with percentage declines as follows: Southeastern Missouri 22 percent, Coeur d'Alene 15, and Utah 27. Output in the Bingham district fell only 9 percent, but that in the Joplin region was 22 percent lower than in 1937. The closing of the Silver King Coalition and Park Utah Consolidated mines early in 1938 was mainly responsible for the fall in output of the Park City region which, in turn, was chiefly responsible for Utah's lower production. The Butte (Mont.) district produced only 204 tons of lead in 1938 compared with 5,780 tons in 1937 and more than 10,000 tons each in 1936 and 1935. Output in the Warm Springs (Idaho), San Juan Mountains (Colo.), and Metaline (Wash.) districts reversed the general downward trend and increased 84, 18, and 52 percent, respectively. Further details of production by mines, districts, and States can be found in the various State reports.

Mine production of recoverable lead in the United States, 1925–29 (average) and 1934–38, in short tons

State	1925–29 average	1934	1935	1936	1937	1938
Western States and Alaska:						
Alaska	982	747	670	941	823	994
Arizona	9,743	3,439	7,783	10,688	12,354	10,571
California	2,070	412	567	482	1,186	495
Colorado	30,112	4,218	5,673	7,267	9,786	9,455
Idaho	141,610	71,324	79,020	91,339	103,711	92,177
Montana	18,871	10,005	15,589	19,059	17,957	9,327
Nevada	9,807	10,991	12,676	10,712	9,347	4,679
New Mexico	6,730	9,365	7,289	6,626	6,512	4,949
Oregon	6	21	30	79	109	23
South Dakota	21	----------	4	----------	----------	----------
Texas	213	360	522	468	395	342
Utah	149,509	58,077	63,510	69,886	89,458	65,657
Washington	1,323	291	103	840	2,830	4,284
Wyoming	----------	1	3	----------	----------	----------
	370,997	169,251	193,439	218,387	254,468	202,953
Central States:						
Arkansas	38	40	38	24	40	7
Illinois	552	40	436	294	186	175
Kansas	26,121	6,805	10,892	11,409	16,008	15,239
Kentucky	135	104	132	50	89	101
Missouri	202,240	90,493	97,493	110,428	157,631	122,027
Oklahoma	58,306	16,747	23,405	25,427	29,840	21,004
Wisconsin	1,745	234	286	904	1,091	320
	289,137	114,463	132,682	148,536	204,885	158,873
Eastern States:						
New York	----------					
Tennessee	} 4,096	} 3,625	4,982	} 5,996	} 5,539	7,896
Virginia						
North Carolina	----------	----------	----------		----------	4
	4,096	3,625	4,982	5,996	5,539	7,900
	664,230	287,339	331,103	372,919	464,892	369,726

Mine production of recoverable lead in the principal lead-producing districts of the United States, 1934–38, in short tons

District	State	1934	1935	1936	1937	1938
Southeastern Missouri region	Missouri	89,580	96,941	108,422	153,205	118,870
Coeur d'Alene region	Idaho	70,331	78,290	86,634	96,505	82,274
Bingham	Utah	32,420	36,293	32,451	45,233	41,334
Joplin region	Kansas, Missouri, Oklahoma.	24,465	34,849	38,842	50,274	39,400
Tintic	Utah	5,715	5,833	7,063	10,198	9,605
Warm Springs	Idaho	8	32	2,757	4,004	7,370
Park City region	Utah	12,360	13,180	17,421	22,417	7,258
San Juan Mountains	Colorado	1,651	2,428	3,279	4,998	5,885
Rush Valley	Utah	5,594	4,907	8,191	6,410	4,619
Eagle	Montana	2,560	1,121	3,113	4,812	4,301
Willow Creek	New Mexico	6,143	5,162	3,746	3,852	4,277
Oro Blanco	Arizona	1,676	4,717	4,426	3,864	4,150
Metaline	Washington	237	(1)	770	2,644	4,009
Wallapai	Arizona	6	70	841	2,489	4,004
Pioche	Nevada	4,644	4,955	4,706	4,759	3,214
Ophir	Utah	1,349	2,392	3,862	3,307	2,013
Old Hat	Arizona	65	292	463	794	1,919
Cataract	Montana	259	1,227	1,704	1,946	1,326
Leadville	Colorado	524	1,288	1,550	2,100	1,222
Hog Heaven	Montana	1	----------	----------	808	1,214
Smelter	do	676	1,239	945	1,178	710
Central	New Mexico	2,846	1,891	2,689	2,281	340
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	234	286	904	1,091	320
Tombstone	Arizona	1,200	1,081	417	315	315
Banner	do	77	857	1,541	1,205	302
Butte	Montana	5,391	10,302	10,527	5,780	204
Flint Creek	do	400	988	1,496	1,511	113
Bisbee (Warren)	Arizona	64	200	1,154	1,018	14
Tybo	Nevada	4,285	5,519	(1)	2,439	----------
Austinville [2]	Virginia	(1)	(1)	(1)	(1)	(1)
St. Lawrence County [2]	New York	(1)	(1)	(1)	(1)	(1)

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

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, 1934–38, in short tons

	1934	1935	1936	1937	1938
Refined pig lead	223, 593	215, 595	165, 159	119, 837	102, 489
Antimonial lead	10, 437	6, 711	6, 697	9, 294	13, 413
	234, 030	222, 306	171, 856	129, 131	115, 902
Lead in base bullion:					
At smelters and refineries	6, 045	15, 072	9, 187	10, 959	18, 693
In transit to refineries	1, 528	1, 860	1, 070	2, 219	2, 339
In process at refineries	11, 567	16, 233	14, 100	14, 413	16, 690
	19, 140	33, 165	24, 357	27, 591	37, 722
Lead in ore and matte and in process at smelters	60, 699	58, 562	50, 098	52, 081	56, 332
	313, 869	314, 033	246, 311	208, 803	209, 956

The upward trend in stocks evident in the last quarter of 1937 continued in the first half of 1938, as production continued to exceed shipments to consumers. During the latter half of the year the trend was reversed following improvement in demand and curtailment of production. Inventories of refined and antimonial lead at refineries reached a peak of 164,600 tons at the end of May, declined to 115,100 tons on December 1, and rose slightly during the last month of the year. The year-end stock of refined and antimonial lead was the lowest since 1930. The decline in the quantity of refined products on hand was offset partly by increases in stocks of base bullion and ore and matte in process.

Published data on the status of foreign lead stocks are not available, but the weak London market during 1938 and the organization of a producer's cartel to balance production and consumption suggests that large stocks of metal are held abroad.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1934 to 1938, inclusive. The figures do not take into account 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 the actual consumption of new lead. The supply available for consumption in 1938 was 24 percent less than in 1937 and was equivalent to only 49 percent of the 1925–29 average. The total consumption of lead, as indicated by the second table following, fell only 20 percent.

Refined primary pig lead available for consumption in the United States, 1934–38, in short tons

	1934	1935	1936	1937	1938
Supply:					
Imports	[1] 283	[1] 1,322	[1] 2,590	2,238	1,905
Production	311,236	324,560	399,156	467,317	383,669
	311,519	325,882	401,746	469,555	385,574
Withdrawn:					
Exports [2]	5,909	6,982	18,313	20,091	[3] 45,866
Supply available for consumption	305,610	318,900	383,433	[4] 449,464	339,708

[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."
[4] Revised figures.

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, 1934–38.

Lead consumed in the United States,[1] 1934–38, in short tons

Purpose	1934	1935	1936	1937	1938
White lead	64,500	80,000	85,500	86,000	71,000
Red lead and litharge	42,000	47,500	54,000	57,000	43,000
Storage batteries	163,000	175,000	191,000	192,000	167,000
Cable covering	35,200	38,900	61,400	90,000	60,000
Building	30,000	32,000	40,000	45,000	36,000
Automobiles	7,300	10,000	11,100	12,000	6,000
Railway equipment	1,100	500	2,400	3,800	1,200
Shipbuilding	200	200	200	300	300
Ammunition	34,800	29,200	32,500	39,500	31,200
Terneplate	2,600	4,700	6,200	6,400	4,300
Foil	16,200	15,900	28,500	21,700	22,000
Bearing metal	12,100	13,000	16,500	15,000	9,000
Solder	16,000	20,000	22,000	22,000	15,000
Type metal	13,000	15,000	17,000	17,000	12,000
Calking	10,000	12,000	13,500	15,000	12,000
Castings	5,000	5,000	5,750	6,000	6,000
Other uses	35,000	40,000	46,000	50,000	50,000
	488,000	538,900	633,550	678,700	546,000

[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.

Lead consumption in the United States in 1938 was 20 percent below 1937 and 44 percent below the record established in 1929. Storage batteries require more lead than any other industry, the quantity so used in 1938 representing 31 percent of the total. This industry fared better than most other important lead-consuming industries, both in relation to 1937 and 1929; the declines were 13 and 20 percent, respectively, from those 2 years. Although it is desirable to have large requirements of lead for the manufacture of storage batteries, lead withdrawn for this use returns quickly to the market in the form of scrap and there competes with primary metal. As one authority stated, lead so used is more in the nature of a loan. The quantity of lead consumed in foil was 1 percent higher in 1938 than in 1937 but 45 percent lower than in 1929, while that used for red lead and litharge, exclusive of the quantities of these pigments consumed in storage batteries, was 25 percent below 1937 but 43 percent above 1929. As has been stated in recent chapters of this series, the principal difficulties of the lead industry from the standpoint of consumption are due to the failure of the utility industry to purchase its proportionate share of the total and the low requirements of the building industry. Quantities used by both of these industries rose in 1937, but they declined again in 1938 and represented only 27 and 38 percent, respectively, of the totals for 1929. White lead is a most important outlet for lead, not only because of the large tonnage involved but particularly because metal so consumed is dissipated. Early in 1939 the Lead Industries Association, with this in mind, announced a 3-year promotion campaign designed to increase the use of white-lead paint.

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 on 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.

The New York quotation for common lead averaged 4.74 cents a pound in 1938, a decrease of 21 percent from 1937 but slightly above the 4.71 cents recorded for 1936. The price was 4.75 cents as the year began, following a decline from 6.50 cents in September 1937. It increased slightly in January but resumed its downward trend at the end of the month, reaching 4 cents at the end of May, the lowest quotation of the year. During this period shipments were continuously below production, and refinery stocks advanced from 90,742 tons at the end of September 1937 to 164,636 at the end of May 1938. A virtual balance between output and shipments was attained in June, and stocks declined from then until December. Heavy buying of lead took place in June and July, and the price advanced 0.75 cent in June to 4.75 cents and continued upward to 5.12½ cents in September. During July and August weakness in the London position deterred price improvement in New York. In September important foreign producers met and decided on a 10-percent reduction in output. This action improved sentiment abroad and reacted favorably on the New York market. Sales were at a high level in the last quarter except for about 4 weeks beginning the middle of November. Sales jumped following a reduction in price to 4.75 cents in December. They were 16,287 tons in 1 week, and the price was raised to 4.85 cents, at which level it closed the year.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1936–38, in cents per pound [1]

Month	1936			1937			1938		
	St. Louis	New York	London	St. Louis	New York	London	St. Louis	New York	London
January	4.35	4.50	3.41	5.85	6.03	5.97	4.72	4.89	3.60
February	4.37	4.52	3.58	6.09	6.26	6.19	4.48	4.63	3.45
March	4.45	4.60	3.69	7.05	7.20	7.20	4.35	4.50	3.56
April	4.45	4.60	3.55	6.03	6.18	5.71	4.35	4.50	3.46
May	4.45	4.60	3.45	5.85	6.00	5.28	4.25	4.40	3.15
June	4.45	4.60	3.40	5.85	6.00	5.03	4.00	4.15	3.09
July	4.45	4.60	3.55	5.85	6.00	5.30	4.73	4.88	3.28
August	4.45	4.60	3.76	6.30	6.46	5.02	4.75	4.90	3.13
September	4.45	4.60	4.05	6.23	6.39	4.63	4.85	5.01	3.27
October	4.49	4.65	4.03	5.56	5.71	4.03	4.95	5.10	3.44
November	4.96	5.14	4.74	4.88	5.03	3.72	4.94	5.09	3.38
December	5.40	5.57	5.60	4.72	4.86	3.54	4.69	4.84	3.15
Average	4.56	4.71	[2] 3.91	5.86	6.01	[2] 5.15	4.59	4.74	[2] 3.33

[1] St. Louis: Metal Statistics, 1939, p. 423. 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, 1939, p. 427. 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 quotations in pounds sterling per long ton, as follows: 1936, £17.6000; 1937, £23.3250; 1938, £15.2667.

The London quotation ranged from a high monthly average of 3.60 cents a pound (United States exchange basis) in January to a low of 3.09 cents in June. It advanced to 3.44 cents in October but declined to 3.15 cents in December. The differential between the selling prices in the New York and London markets was much higher in 1938 than in 1937. It was lowest in March (0.94 cent) and highest in August (1.77 cents). The difference in price averaged 1.41 cents for the year compared with 0.86 cent in 1937 and 0.80 cent in 1936.

FOREIGN TRADE [2]

The foreign trade of the United States in lead consists largely of imports of ore and base bullion, which are smelted and refined in bond, and the export of this lead either as pig lead or in manufactured products. This trade reached a peak in 1927 but dwindled to very small proportions in 1933. Since then, however, there has been substantial improvement. Imports of lead in ore, base bullion, and refined and scrap lead totaled 161,389 tons in 1927, 7,654 tons in 1933 and 63,901 tons in 1938; exports of refined lead decreased from 125,267 tons in 1927 to 5,909 in 1934 and advanced to 45,866 tons in 1938. In the same years exports of lead in manufactures with benefit of draw-back were 12,004, 7,472 and 9,061 tons, respectively.

Imports.—Total imports of lead in ore and matte, including imports for immediate consumption and entries for warehouse, increased 33 percent in 1938 owing chiefly to larger shipments from Mexico, Australia, and Chile. Imports of base bullion from Mexico likewise

[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.

increased substantially, but the quantity of refined lead and scrap received from abroad declined. Most of the refined lead imported in 1938 came from Peru. Total imports of lead in all the above forms increased 57 percent over 1937.

Total lead imported into the United States, 1934–38, by classes, in short tons [1]

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, sheets, and old	Total lead content
1934	10,611	2,450	283	13,344
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

[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, 1934–38, by countries, in short tons [1]

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1934	1,160	3,270	3,357	5,455	67	35	13,344
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

[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, 1934–38, by countries, in short tons [1]

Country	1934	1935	1936	1937	1938
In ore and matte:					
Canada	902	58	1,419	5,211	3,173
Chile	1,443	1,102	574	474	2,107
Mexico	1,283	7,986	10,462	15,970	24,023
Newfoundland	3,357	6,818	3,955		
Peru	3,545	3,716	4,007	10,132	9,317
Other countries	81	345	296	2,316	6,750
	10,611	20,025	20,713	34,103	45,370
In base bullion:					
Mexico	1,987	1,746	39	1,067	14,444
Peru	463	784	52	239	198
Other countries		162	221	494	654
	2,450	2,692	312	1,800	15,296

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

Lead remaining in warehouses in the United States, Dec. 31, 1934–38, 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]
1934	15,709	606	1937	57,509	2,622
1935	22,598	2,173	1938	76,287	11,524
1936	33,401	1,930			

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

Lead[1] imported for consumption in the United States, 1934–38, 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		
1934	10,760	$558,558	2,220	$117,729			286	$35,130	$12,940	$735,035
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

[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; and 189 tons, $20,374 in 1938; value included in total value.

Miscellaneous products containing lead imported for consumption in the United States, 1934–38

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
1934	709	102	$71,505	112	94	$6,784
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

Exports.—Exports of pigs, bars, and old lead more than doubled in 1938 as a result of the increase in custom smelting and refining of foreign ores and base bullion. A large part of the increase was credited to Japan, which purchased over four times as much in 1938 as in 1937. During the past 3 years substantial tonnages have been shipped to Mexico. This lead was base bullion derived from Mexican ores and returned to Mexico for refining.

Lead exported from the United States 1934–38 [1]

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	
1934	5,909	$305,994	7,472	1937	20,091	$1,838,262	8,679
1935	6,982	472,017	8,995	1938	[2] 45,866	[2] 3,354,616	9,061
1936	18,313	1,390,454	8,312				

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

Pig lead [1] *exported from the United States, 1934–38, by destinations, in short tons*

Destination	1934	1935	1936	1937	1938
Countries:					
Argentina	(2)		3	8	10
Brazil	475	338	795	652	110
Canada	21	45	45	7	101
Finland					560
Germany		11	2	568	1,092
Japan	4,454	5,324	8,629	7,320	30,203
Kwantung					314
Mexico	21	38	8,049	8,122	11,403
Netherlands	4	188			
Philippine Islands	169	217	223	569	1,037
United Kingdom	36	8	123	2,226	78
Uruguay	221	112			
Other countries	508	701	444	619	958
	5,909	6,982	18,313	20,091	45,866
Continents:					
North America	107	157	8,282	8,337	12,002
South America	1,076	668	1,021	784	303
Europe	40	212	133	2,949	1,950
Asia	4,684	5,945	8,865	7,989	31,606
Africa and Oceania	2	(2)	12	32	5

[1] Includes small quantities of foreign lead reexported.
[2] Less than 1 ton.

TECHNOLOGY

Mining.—Ore pillars in the Southeast Missouri district are being mined and replaced with concrete. Preliminary attempts on some of the smaller pillars have been successful, and plans are under way for mining larger blocks of ore left for roof support. One of the major problems involved is the determination of the load carried by the pillar in order that the volume of concrete used may be kept at a minimum compatible with safety. In this connection the Bureau of Mines method [3] of ascertaining rock pressures by measuring the velocity of sound is being investigated as a practical means of measuring the load on the pillars.

Probert [4] and Parks [5] have summarized progress in mining technique during 1938, and articles by Schmitt [6] and Behre [7] review recent developments in mining geology. Drilling practice in the Tri-State region has been described by Nicolson.[8]

Milling.—According to Engelmann, Minerec A is now being used in about 80 percent of the western lead-zinc mills, where it has partly or completely replaced xanthate in the lead circuits. The new sloping-side Fagergren flotation machine has found favor with lead-zinc operators.[9] Fahrenwald [10] reports substantial improvement in ore-dressing practice and equipment during 1938. A method of treating lead-zinc-fluorspar ores by flotation has been developed by the Bureau

[3] Obert, Leonard, Measurement of Pressure on Rock Pillars in Underground Mines: Bureau of Mines Rept. of Investigations 3444, 1939, 13 pp.
[4] Probert, Frank H., Some Trends in Mining Practice: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 68–69.
[5] Parks, R. D., Mining Progress: Min. and Met., vol. 20, No. 385, January 1939, pp. 3–5.
[6] Schmitt, Harrison, Mining Geology Looks Toward Realism: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 69–73.
[7] Behre, Chas. H. Jr., Mining Geology: Min. and Met., vol. 20, No. 385, January 1939, pp. 16–18.
[8] Nicolson, C. W., Recent Improvements in the Mining Practice of the Tri-State District: Am. Inst. Min. and Met. Eng., Min. Technol., vol. 2, No. 3, May 1938, 17 pp.
[9] Engelmann, E. W., Ore Concentration and Gold Milling: Min. and Met., vol. 20, No. 365, January 1939, pp. 13–16.
[10] Fahrenwald, A. W., Older Ore Dressing Practices Restudied: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 73–75.

of Mines.[11] The mill of the Hecla Mining Co. at Gem, Idaho, has been modernized and the capacity increased to 900 tons of ore per day.

Smelting.—According to Oldright,[12] advance in lead smelting during 1938 was confined to further development of previously established practice. The tendency toward adoption of wider sintering machines and efforts to increase the capacity of blast furnaces continued. Fleming [13] called attention to the fact that more than 500 tons of charge yielding a slag containing 20 percent zinc are now being treated daily in a standard-size blast furnace at Port Pirie. Formerly such tonnages were realized only when the zinc content was low. In refining lead the removal of bismuth always has been troublesome, particularly in producing corroding grades. The use of magnesium and potassium for this purpose has been proposed (United States Patent 2,133,327, October 18, 1938).

WORLD ASPECTS OF LEAD INDUSTRY

International cooperation.—Unsatisfactory conditions in the lead industry during the latter part of 1938 culminated in a meeting of the principal foreign producers in London on September 6 at which the Lead Producers Association was formed. The official communique issued after the meeting gave few details but indicated that the object of the cartel was to restrict output to balance it more nearly with consumption and thus improve prices. According to press reports membership included producers in Australia, Burma, Yugoslavia, and Canada, as well as the American Smelting & Refining Co., which has extensive lead-mining interests in Mexico, Australia, and Newfoundland. This group represents 60 to 75 percent of the foreign lead production, and it is planned to invite other producers to participate in the scheme. Effective November 1 a 10-percent reduction in production was agreed upon with further curtailment to be declared if the market failed to improve. This was the first positive action taken to control the lead market since the International Association of Lead Producers collapsed in 1932 as a result of the imposition of an import duty on lead in the United Kingdom. However, world producers have cooperated in exchanging statistics for several years.

World production.—World smelter production of lead in 1938 fell 4 percent below the total for 1937 and was equivalent to 91 percent of the record output in 1929. The relatively good showing made in 1938 was due to the fact that output abroad was at the highest levels ever attained, slightly exceeding the previous record of 1937, although production in the United States declined 22 percent. The 10 principal producers and the percentage of the total output each contributed in 1938 were: United States 20, Australia 15, Mexico 13, Canada 11, Germany 11, Belgium 5, Burma 5, the U. S. S. R. 4, Italy 3, and France 3. Of the important lead-smelting countries, Australia showed an increase of 1 percent, Germany 6, Burma 3, the U. S. S. R. 13, Italy 11, and France 12. There was very little change in the Canadian rate of

[11] 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.

[12] Oldright, G. L., Lead Smelting Practice Advances: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 79-80.

[13] Fleming, E. P., Metallurgy of Lead: Min. and Met., vol. 20, No. 385, January 1939, pp. 20-21.

activity, but output in the United States dropped 22 percent, that in Mexico 7 percent, and that in Belgium 9 percent. Of the smaller producers, Peru almost doubled its output, following a substantial increase in 1937, and Spain and Poland also registered notable gains. The British Empire produced about 508,000 metric tons of smelted lead in 1938, about the same quantity as in 1937. Since the 5-year period 1925–29, the Empire share of world output has advanced from 22 to 31 percent, whereas that of the United States has dropped from 42 to 20 percent. The share of the British Empire rose from 30 percent in 1937 to 31 percent in 1938, while that of the United States fell from 25 to 20 percent.

World production of lead, 1934–38, in metric tons [1]

[Compiled by R. B. Miller]

	Country	1934	1935	1936	1937	1938
	Argentina	5,047	4,103	10,700	11,400	(2)
2	Australia	199,151	221,431	196,051	232,198	235,664
	Belgium	74,750	68,980	67,000	93,310	84,600
	Burma	71,692	73,217	74,329	77,728	80,166
5	Canada	142,635	148,558	164,857	181,162	181,783
	China	1,665	[3] 1,600	[3] 1,600	[3] 1,500	(2)
	Chosen	1,806	1,728	2,738	5,850	(2)
	Czechoslovakia	3,474	3,986	4,126	4,300	4,300
	France	31,143	14,575	14,500	37,168	41,753
4	Germany [4]	119,980	122,300	139,000	162,400	171,700
	Austria	5,629	8,048	8,732	10,836	9,280
	Greece	8,023	4,679	4,172	5,890	4,535
	Hungary	42	14	26	147	(2)
	Indochina	15	18	12	8	(2)
	Italy	47,397	35,803	36,307	38,938	43,310
	Japan	7,039	7,442	8,883	10,200	12,000
3	Mexico	165,416	177,630	214,376	223,678	207,075
	Northern Rhodesia	187	185	305	568	277
	Norway	333	577	227	236	(2)
	Peru	1,536	6,452	8,899	15,787	28,478
	Poland	10,350	18,819	15,021	17,587	19,973
	Portugal	54				
	Rumania	4,382	4,557	4,783	6,725	(2)
	South-West Africa				1,355	3,214
	Spain	72,151	62,742	46,600	30,000	36,000
	Tunisia	27,311	25,390	21,497	24,758	23,790
	Union of South Africa					19
	U. S. S. R.	27,174	44,853	50,800	[3] 55,000	[3] 62,000
	United Kingdom	9,100	22,350	13,800	10,313	9,847
1	United States (refined) [5]	281,300	294,075	362,055	423,232	330,963
	Yugoslavia	9,803	7,554	5,804	4,038	8,646
		1,329,000	1,382,000	1,477,000	1,686,000	[3] 1,625,000

[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.—The American Bureau of Metal Statistics reports world consumption of lead in 1938 as 1,634,600 metric tons, a decrease of 6 percent from the peak of 1937 but, except for 1937 and 1929, the highest ever registered. Record-breaking consumption abroad, where the total was 2 percent above the previous high in 1937, partly offset the drop of 26 percent in consumption in the United States. Compared with the estimated use of lead in 1929 consumption in the United States declined 45 percent, while that in the rest of the world increased 24 percent. In 1938 the United Kingdom consumed more lead than ever before and supplanted the United States as the principal lead-consuming country of the world, using 24 percent of the total. The United States used 22, Germany 15, Japan 6, U. S. S. R. 6, France 5, Italy 3, and the Netherlands, Belgium, Australia, New Zealand, and Sweden, about 2 percent each.

REVIEW BY COUNTRIES

Australia.—The small increase in smelter output in 1938 was due to the larger production of Mount Isa which rose from 38,460 long tons in 1937 to 41,512 in 1938. Output at Port Pirie was approximately 190,000 tons in both years.

At Broken Hill production of crude ore increased from 1,468,000 tons in 1937 to an estimated 1,545,000 tons in 1938. The New Broken Hill mine is expected to begin production in 1940. Enlargement of facilities at the adjoining property of Zinc Corporation, Ltd., which is to treat the ore from the North Broken Hill mine, continued during 1938. North Broken Hill, Ltd., began operation of its new 50,000-ton-per-month concentrator in April 1939. The Broken Hill Proprietary mine was closed owing to exhaustion in February 1939. During a life of over 50 years the mine had produced 1,445,000 tons of lead and 189,457,000 ounces of silver.

The Lake George mine began producing in January 1939 when its new 500-ton-per-day mill was started. The ore contains approximately 8 percent lead, 12 percent zinc, and 2.5 ounces of silver per ton. A second 500-ton unit is planned.

Exports of lead ore and concentrates totaled 36,000 tons in 1938 compared with 34,500 in 1937. Exports of base bullion and refined lead declined from 203,000 to 195,000 tons. The metal went chiefly to Europe; Japan's purchases declined from 5,300 to 1,100 tons.

Belgium.—Smelter production of lead, which fell 9 percent from the peak established in 1937, is based on foreign ore, imports of which fell from 133,000 metric tons in 1937 to 107,000 in 1938. There were sharp declines in receipts from Yugoslavia, Sweden, Peru, and Canada, but shipments from Argentina and Bolivia increased. Imports of pig lead totaled 28,000 tons (mostly from Mexico), a slight advance over 1937. Exports of pig lead dropped from 68,000 to 67,000 tons. Loss of markets in France and Germany was largely offset by improved sales to the Netherlands.

Production of lead ore near Kengere (Katanga, Belgian Congo) is being stepped up, and monthly shipments to the smelter at Hoboken, Belgium, are anticipated. Belgian imports from this source were 6,400 tons in 1938.

Burma.—The Burma Corporation, Ltd., produced 99,773 long tons of lead concentrates containing 65 percent lead and 42 ounces of silver per ton compared with 107,073 tons containing 66 percent lead and 45 ounces of silver in 1937. The output of refined lead, however, increased from 76,500 to 78,900 tons and that of antimonial lead from 1,150 to 1,200 tons. In 1938, 5,920,000 ounces of refined silver were recovered compared with 6,180,000 ounces in 1937.

Canada.—Mine production of lead increased from 206,000 to 209,500 short tons. British Columbia produced nearly 99 percent of the 1938 total and the Yukon Territory slightly over 1 percent. No production was reported from Quebec and Nova Scotia in 1938.

At the Sullivan mine in British Columbia the concentrator treated 2,273,000 tons of ore which contained 15.83 percent combined lead and zinc and 4.02 ounces of silver per ton compared with 2,220,000 tons in 1937 which contained 16.46 percent lead and zinc and 4.2 ounces of silver. The smelter produced 211,500 tons of bullion compared with 204,700 tons in 1937. Smelter recoveries surpassed previous records, but mill recoveries were 0.50 percent below 1937. Costs were reduced slightly. The refinery produced 201,400 tons of refined lead and 9,764,000 ounces of silver. Net profits for 1938 were $6,214,000 compared with $14,670,000 in 1937. The lead plants at Trail were described by Huttl.[14]

Exports of pig lead fell from 177,000 to 155,000 tons. Shipments to Japan decreased from 43,000 to 17,000 tons, whereas those to the United Kingdom increased from 115,000 to 120,000 tons. The lead content of ore exported in 1938 was only 3,600 tons.

France.—Consumption of lead in France in 1938 is estimated at 86,000 metric tons, a 20-percent decrease from 1937. Smelter production was 12 percent higher, and imports of lead ore advanced from 43,000 to 52,000 tons, larger tonnages having been received chiefly from Morocco and Yugoslavia. Imports of pig lead declined from 73,000 to 47,000 tons, as shipments from Tunisia, Belgium, and Mexico decreased. In 1938, as in 1937, there were virtually no imports from Spain. Approximately 11,000 tons of lead ore were exported in 1937 and 1938.

The subsidy to French and French Colonial metal mines, suspended in October 1936 when prices were high, was reinstituted in June but apparently did not benefit lead producers during 1938.

Germany.—A 6-percent rise in smelter output was accompanied by an 11-percent increase in imports of lead ore from 127,000 metric tons in 1937 to 141,000 in 1938. If an average lead content of 65 percent is assumed, imported ore furnished more than 50 percent of the smelter production in 1938. Yugoslavia supplied 27 percent of the 1938 ore imports, Newfoundland 22 percent, Bolivia and Peru 21 percent, Australia 10 percent, and other countries 20 percent. Apparent consumption of lead increased from 235,300 to 246,500 tons and imports of pig lead from 73,300 to 75,300 tons. Mexico supplied 42,600 tons of pig lead in 1938 and Peru 8,400 tons.

In annexing Austria and Czechoslovakia, Germany acquired some lead resources but increased its dependence on foreign sources of supply. Austria's mine output was approximately equal to its consumption, but Czechoslovakia has been a net importer of 10,000 to 15,000 tons of lead annually. Active development of Austria's lead deposits is indicated by the announcement that the Bleiberger Bergwerks union has been absorbed into the raw-materials organization of the Four Year Plan. Production of lead and zinc ores and metallic lead is to be increased, and a detailed investigation of the lead-zinc resources of Karinthia and the eastern Alpine regions will be undertaken.

Italy.—Further progress was made in increasing the domestic production of lead ores, which advanced from 59,000 metric tons in 1937 to an estimated 66,000 tons in 1938. Smelter output thus rose 11 percent, while imports of lead ore increased only slightly—from 13,500

[14] Huttl, John B., Producing Lead at Trail: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 34–38.

to 13,700 tons. Apparent consumption totaled 51,900 tons in 1938 compared with 50,400 tons in 1937, and imports of pig lead declined from 10,900 to 8,600 tons. The principal lead mines are in Sardinia, and efforts are being made to expand production there. Italy expects to be independent of foreign sources of lead by 1940. The deposits in the Arbus area in southwest Sardinia were described recently by Wright.[15]

Japan.—Because publication of statistics on the mineral industries has been discontinued, details of the lead industry in 1938 are not available. The American Bureau of Metal Statistics estimates consumption at 100,000 metric tons, a decrease of 20,000 tons from 1937. This sharp decline is substantiated by the reduction in exports to Japan from Canada and Australia.

Japan imports over 90 percent of its lead, and because of the shortage of foreign exchange and the need of lead for military purposes its use in many other outlets has been restricted. On March 23, 1938, the importation of lead was placed under Government license, and on July 15 regulations were promulgated restricting the consumption of lead and other metals.

A Japanese company has been formed to develop lead, zinc, and copper mines at Tienpaushan, Chientao Province, Manchuria.

Mexico.—Mine production of lead increased from 218,133 metric tons in 1937 to 282,369 in 1938—29 percent; smelter output decreased 7 percent. Production of refined lead at the two refineries at Monterrey declined from 222,057 to 202,411 tons; the Penoles plant supplied 30 percent of the 1938 output and the A. S. & R. plant 70 percent. The latter was closed from November 18, 1938, to March 22, 1939, because of a strike. In August 1938 a 12-percent export tax was imposed on the appraised value of goods exported. Presumably this action was designed to give the Government the benefits accruing to exporters from the decline in the exchange value of the peso. The official value assigned for lead for the purpose of computing the tax was 0.98 cent per pound from August 10 to November 20, when it was increased to 1.10 cents.[16] As these values were substantially below world prices, the actual tax was considerably below 12 percent of the actual value of the metal exported. There has been no further news regarding the proposed lead smelter to treat labor-cooperative ores, mentioned in Minerals Yearbook, 1938.

Constantly increasing taxes and demands of labor have created hardships for many companies operating in Mexico. This is illustrated vividly by the following remarks of the chairman of the San Francisco Mines of Mexico, Ltd., at the shareholders' meeting in February 1938.

> In short, the technical position at the mine continues to be satisfactory. In order to maintain this position, however, a very active development program must be carried out, and we hope that the Mexican Government and Mexican labor will in their own interests do all they can to assist us in this.
>
> This brings me to labor. Our new collective contract was signed on the 26th February, 1937, but was retrospective to the 5th November, 1936, so that for 11 months of the year we were paying the higher rates. With its signature we had hoped we should be allowed at least a short period in which to carry on our operations without labor interference. I am sorry to say that this has not been the

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[15] Wright, Charles Will, The Lead-Zinc Deposits and Geology of the Arbus Area in Sardinia, Italy: Econ. Geol., vol. 34, No. 1, January–February 1939, p. 82.

[16] Hubbell, A. H., Mexico: Eng. and Min. Jour., vol. 140, No. 2, February 1939, p. 60.

case. It is true that the collective contract has not been upset, but we have been continually subjected to demands from labor, strike threats, incipient sit-down strikes, ore thefts, interference in management, and a general lessening of efficiency and discipline throughout the organization. At this very moment there is a sit-down strike of 1 hour daily for some unspecified reason. The executives at the mine, who anyway have a full-time job looking after the technical work, have had to devote much of their time and a great deal of overtime to handling labor matters. Inefficient labor and harassed officials must have an effect on operations. Conditions are now such that the company cannot bear further burdens, and accordingly I speak with the utmost frankness.

As I said before, the mine is now virtually being run for the employees. One hears in Mexico of talk of expropriation, but in the case of mining I believe the Mexican Government realizes that the Government itself or the Sindicatos could not run the mine as efficiently as can a technical staff highly skilled at the job and with long experience of the mine. In other words, under its present highly skilled management the mine has its best chance of weathering this stormy period of low metal prices. But the Mexican Government and Mexican labor must surely realize that shareholders, management, and British financial interests will not be content to give their cooperation if the reward is inadequate. It is not sufficient that the reward should only be forthcoming when base metals are at peak prices.

It should be borne in mind that the burden placed upon us by increased wages, social legislation and Government, and labor interference with operations does not finish the story. Cost of supplies, import duties, railway freights, loading charges at port, metal productions tax, salaries, and, in fact, nearly everything which enters into our costs of production have been stepped up.

Newfoundland.—Approximately 459,000 short tons of lead-zinc ore were milled during 1938, which yielded 47,100 tons of lead concentrates containing 27,400 tons of lead and 487,000 ounces of silver; 41,400 tons of concentrate were produced in 1937 and 46,000 tons in 1936.

Peru.—Exports of lead ore declined from 24,600 metric tons in 1937 to 18,800 in 1938, whereas shipments of concentrates increased from 22,000 to 34,000 tons and of refined lead from 15,800 to 28,500 tons. The Cerro de Pasco Copper Corporation increased its lead output from 19,000 to 26,000 tons.

Spain.—Owing to the civil war little information as to activity at Spanish lead mines has been available. However, in May 1938 it was reported that the Renteria smelter, which treats the lead concentrates from the Reocin mine, Santander, was producing at the rate of 5,000 tons annually. The lead mines of Linares, Cartagena, Magarron, and Jaen were in Government territory and those at Penarroya, Malaga, Cordoba, and Reocin in Nationalist territory throughout most of 1938.

United Kingdom.—Consumption of pig lead, as estimated by the British Metal Corporation, Ltd., totaled 344,000 long tons in 1938 compared with 337,000 tons in 1937. Of the 1938 total, 58 percent was used in sheet and pipe, white lead, oxides, etc.; 27 percent in cable; 7 percent in batteries; and 8 percent for miscellaneous purposes. The use of lead in cable and batteries increased 18 and 14 percent, respectively, over 1937, whereas its use in the other two items declined. Stocks of lead in official warehouses increased from 7,000 tons on January 1 to 11,000 on December 31, 1938. Only 3 percent of the domestic requirements was supplied by local smelters. Imports of pig lead increased from 373,000 tons in 1937 to 407,000 in 1938; 88 percent of the 1938 total was obtained from Australia, Canada, and Burma and the remainder chiefly from Mexico. Mexican shipments dropped from 44,500 to 41,500 tons. Reexports of pig lead decreased from 37,000 to 25,000 tons, and exports of lead and lead manufactures rose slightly from 13,500 to 14,500 tons.

Despite the lower prices for lead in 1938, mine output was maintained at 38,100 tons of 78-percent concentrates compared with 39,100 tons in 1937. Some concentrate is exported to continental smelters. Exploration of old lead mines in the vicinity of Eyam, Derbyshire, is under way.

Yugoslavia.—Exports of lead concentrates again increased, totaling 89,500 metric tons in 1938 compared with 84,400 tons in 1937; Belgium took 70 percent of the 1938 shipments. Trepca Mines, Ltd., treated 655,892 tons of ore in the fiscal year ended September 30, 1938, compared with 638,729 tons in the previous fiscal year. Production of lead concentrates (79 percent lead) increased from 70,500 to 73,000 tons. Mill recoveries of more than 97 percent are being obtained. In August 1938 the properties of the Kapaonik, Zletovo, and Novo Brdo companies were absorbed by Trepca Mines, Ltd. An agreement has been made with the Government whereby Trepca, through a subsidiary company, will build a lead smelter at Zvecan. Initial annual capacity of the plant is to be 12,000 tons of metal, but it is expected that by 1941 the entire lead output of the Trepca group will be smelted in Yugoslavia.

ZINC [1]

By E. W. PEHRSON

SUMMARY OUTLINE

The statistical record indicates that the zinc industry experienced an unsatisfactory year in 1938. Smelter production from domestic ores declined 21 percent compared with 1937, apparent consumption was a third less, producers' stocks at the end of the year nearly doubled, and the average price at St. Louis declined almost 2 cents per pound. During the first 6 months domestic shipments were 45 percent below the average rate for 1937. As production was not reduced proportionately, stocks soared and prices dropped. By the end of June producers' stocks exceeded the depression high established in 1930, and in May prices fell to the lowest level since April 1935. Beginning in May, however, business improved steadily; by November shipments more than doubled those for the low point reached in April, and there was a substantial decline in inventories. Prices also improved, but the advance was restricted by the unsettled market in London and falling sterling exchange rates. The St. Louis quotation for prime western zinc fell from 5.00 cents at the beginning of the year to 4.00 cents in May but rose to 5.05 cents about the middle of October where it stayed until November 21. Two price cuts during the latter part of November lowered the quotation to 4.50 cents, where it remained throughout December, in which month deliveries to consumers declined and stocks again increased. From April to November 15 the differential between New York and London prices increased from 1.50 to 2.42 cents per pound; at the close of the year the differential was 1.98 cents. Imports were much lower in 1938, having declined 81 percent from the peak established in 1937, when a threatened shortage of domestic metal due to temporary conditions prompted large purchases abroad.

[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.)

Salient statistics of the zinc industry in the United States, 1925–29 (average) and 1934–38

	1925–29 (average)	1934	1935	1936	1937	1938
Production of primary slab zinc:						
By sources:						
From domestic ores...short tons..	589,648	355,366	412,184	491,803	551,165	436,007
From foreign ores.............do....	12,734	8,224	8,450	329	5,739	10,334
	602,382	363,590	420,634	492,132	556,904	446,341
By methods:						
Electrolytic.......percent of total..	21	21	28	26	21	21
Distilled...................do....	79	79	72	74	79	79
Production of redistilled secondary slab zinc.........................short tons..	43,756	19,691	28,650	42,209	51,554	31,613
Stocks on hand at primary smelters Dec. 31.........................short tons..	45,575	124,783	90,539	55,500	79,144	157,511
Primary zinc available for consumption short tons..	548,472	345,914	457,705	538,794	570,219	375,004
Price—prime western at St. Louis:						
Average for year.....cents per pound..	6.76	4.16	4.33	4.90	6.52	4.61
Highest quotation...............do....	8.90	4.40	4.95	5.45	7.50	5.05
Lowest quotation...............do....	5.40	3.67½	3.70	4.75	5.00	4.00
Price—yearly average at London.....do....	6.46	3.07	3.08	3.31	4.91	3.05
Mine production of recoverable zinc short tons..	724,720	438,726	517,903	575,574	626,362	516,699
Tri-State district (Joplin) percent of total..	49	35	37	39	38	38
Western States.................do....	30	29	31	31	31	28
Other.............................do....	21	36	32	30	31	34
World smelter production of zinc short tons..	1,435,000	1,287,000	1,467,000	1,608,000	1,785,000	1,717,000

The outstanding event of the year was the announcement of a 20-percent reduction in the tariff on zinc and zinc ores effective January 1, 1939. Under the Canadian Trade Agreement signed November 17 the new duty on slab zinc was fixed at 1.40 cents per pound, a reduction of 0.35 cent from the previous rate of 1.75 cents in effect since 1922. Owing to the surplus of foreign zinc in recent years, London prices have been depressed to such an extent that domestic producers frequently have been threatened with loss of domestic markets through importation. As the old tariff has been nearly 100 percent effective during this period, it follows that the reduction in duty will have to be absorbed by domestic producers if they are to maintain their position in the home market. According to trade authorities this was done on November 21, 1938, when domestic quotations were cut 0.30 cent per pound.

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

Outside the United States apparent consumption increased 3 percent to a new all-time record. Armament probably has accounted for a large part of the increase in foreign consumption of zinc in recent years. It is interesting to note that Germany, Japan, and the U. S. S. R. recorded further increases in 1938, whereas the United Kingdom and France scored decreases. Production abroad likewise continued its steady rise of the previous 5 years and established a new high record. Supply exceeded demand, there were further accretions to producers' stocks of metallic zinc, and large quantities of concentrates are said to be held at the mines. As a consequence of the superabundance of zinc London quotations in sterling sagged to the lowest yearly average since 1933, reaching an extremely low level early in June. Some improvement was noticeable in the last half of the year, but this was offset to a considerable extent by a substantial drop in the foreign exchange value of the pound. Low prices stimulated efforts to revive the Zinc Cartel, but such efforts proved to be fruitless, and at the end of the year the outlook for any relief through cooperative action was dismal.

Reduction in tariff.—The 20-percent reduction in the import duty on zinc resulting from the Canadian Trade Agreement signed November 17, 1938, aggravated the already unfavorable competitive position of the domestic zinc industry. As stated in Minerals Yearbook, 1938, domestic producers are at a disadvantage in comparison with foreign producers because of the lower grade of ore found in domestic deposits.

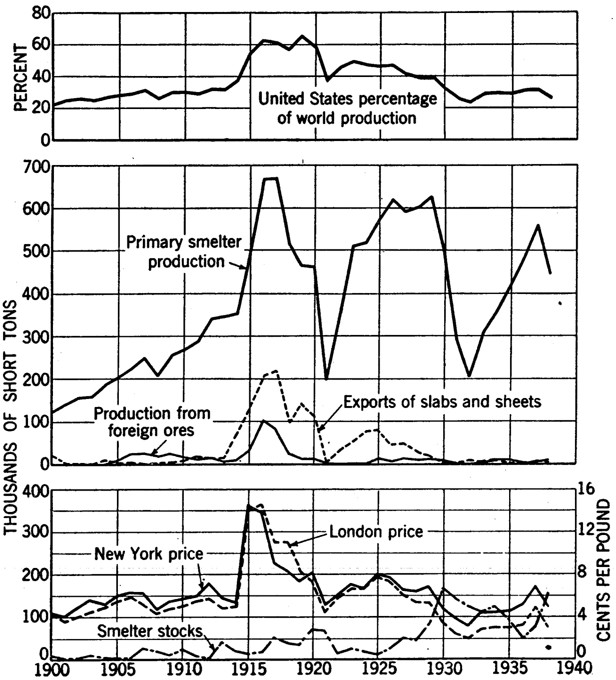

FIGURE 1.—Trends in the zinc industry in the United States, 1900–1938. Imports of slab and sheet zinc are not shown, as they seldom exceed 500 tons annually. In the last few years, however, they have increased, amounting to 11,902 tons in 1936, 37,439 in 1937, and 7,456 in 1938.

Costs of production in the United States also are influenced by higher wage rates in this country. Formerly these basic disadvantages were offset partly by superior technology and mechanization, but in recent years American mining practice has been adopted abroad, particularly at several properties that have begun production in the last decade, and foreign costs of production have been reduced accordingly. The increased output of these new mines has been augmented by subsidized production from submarginal deposits in various countries striving for self-sufficiency and by increased capacity and improved recovery at older mines, all of which have resulted in considerable overproduction. Stocks of both ore and metal have accumulated at mines and smelters with depressing effects on world prices.

During the 10-year period 1920–29 the London quotation for prompt metal averaged 6.3 cents per pound. Since then the average has been 3.2 cents, almost a 50-percent decline. New York quotations for the same periods averaged 6.9 cents and 4.8 cents, respectively. That the tariff has been highly effective since 1929 is indicated by the rise of 0.6 cent to 1.6 cents per pound in the average differential between New York and London prices.

Despite the fact that the previous tariff prevented a more drastic drop in domestic prices, zinc mining in many districts of the United States has not been profitable enough in recent years to induce adequate expenditure for exploration and development needed to maintain ore reserves; thus the basic position of the industry has been jeopardized by lack of proper provision for its future. As a consequence some domestic producers considered requesting Congress for further tariff protection as early as 1936 when events abroad prevented the New York quotation from rising above 5.25 cents. Action was postponed, however, by the rise in prices during the extraordinary boom in metals late in 1936 and early in 1937 and by the temporary shortage of zinc in the summer of 1937. After the sharp recession of prices in 1938 the industry was facing the same outlook as in 1936 with the added handicap of a 20-percent cut in its tariff protection.

The ultimate effects of the tariff reduction on the domestic zinc industry cannot be determined at this time. As the previous import duty (1.75 cents per pound) was virtually 100 percent effective prior to the announcement of the Canadian Trade Agreement, it is obvious that to avoid large imports of foreign metal, the domestic price of zinc must be reduced in relation to London prices by approximately the amount the import duty was cut. An immediate effect of the reduction, therefore, has been aggravation of an already serious condition that has resulted from and will continue as long as the depressed market exists abroad.

A review of the present status of foreign production indicates that the foreign price of zinc will remain below predepression averages for an extended period. During the last several years large new producers in Yugoslavia, Newfoundland, northern Spain, Australia, and Canada have come into the market. At most of these properties zinc concentrates are produced largely as a byproduct, and the cost of mining and milling the crude ore is borne by other products, principally lead and silver. Consequently the out-of-pocket cost of zinc concentrates is relatively low because it comprises only the expense of separating the zinc minerals after the ore is mined and crushed. Producers are thus content to sell the zinc at a price that yields a profit over the out-of-pocket cost.

Notwithstanding the low level of prices and the overabundance of present foreign capacity, plans are under way for increasing capacity at several properties, and new mines are being developed. The practice of subsidizing submarginal mines continues to expand, particularly in Germany. The world's demand for zinc evidently can be supplied for many years at prices far below former averages. This conclusion is substantiated by the fact that, except during the boom in 1937, world prices have not returned to predepression levels, although foreign consumption has increased steadily since 1932 and has established new peaks during the past 4 years. In 1938 foreign consumption of zinc was 20 percent greater than in 1929, yet the average London price was only 3.05 cents per pound compared with 5.40 cents in 1929.

Much of the advance in consumption has been due to military preparations engendered by the tense international situation. Should the situation be settled without resort to war the demand for zinc for munitions probably would end abruptly. Substantial quantities of zinc now on hand in matériel might be thrown on the market as scrap, which would add to the present excess.

If all factors are considered the outlook for prices satisfactory to the domestic zinc industry is unfavorable owing to the situation in the foreign market. Substantial improvement there depends primarily on the extent to which producers can cooperate to avoid overproduction. Failure of the various attempts to reestablish the Zinc Cartel since it collapsed in 1934 offers little hope of immediate success in this direction. The recent large increase in the import duty on non-British zinc in the United Kingdom, the self-sufficiency programs of various nations, the shortage of foreign exchange, and the intense competition for the remaining open markets appear to be almost insurmountable obstacles.

If the domestic industry is to continue to supply national requirements it must become adjusted to the lower price level, to which has been added a reduction of 0.35 cent per pound in tariff protection. To do this, costs of production will have to be reduced, chiefly by lowering wages and by selective mining of the higher grade portions of ore deposits, neither of which is desirable. Reduction of wages is contrary to present Government policies of increasing purchasing power, and the robbing of ore bodies is decidedly anticonservational and detrimental to the long-time welfare of the industry.

The alternative would be loss of part of the domestic zinc market to foreign producers. From the standpoint of public interest this likewise would be undesirable because it would aggravate the unemployment problem. Dr. John W. Finch, Director of the Bureau of Mines, has pointed out that it would also be undesirable from the standpoint of national defense. In an address on strategic minerals at the annual meeting of the American Zinc Institute at St. Louis in April 1938 he emphasized the importance of preserving industries that now provide self-sufficiency in important industrial minerals, as follows:

> In this connection I should like to suggest that a reduction in the present tariff on lead and zinc can hardly be considered in the public interest if viewed from the standpoint of national defense. The fact that these metals are produced in large quantities in neighboring countries is not adequate protection, as we have no assurance that supplies could be obtained from these countries in an emergency except at exorbitant cost or by military effort. It seems to me that the maintenance of the security afforded by our ability to supply our own needs of these important industrial raw materials should receive careful consideration.

In the past 12 months the domestic zinc industry has suffered drastic curtailment. Several mines and one smelter, which resumed operations in 1937 after protracted shut-downs, were forced to close again in 1938 on account of low prices. It has been reported that production has continued at many mines in the Tri-State area where the selling price of the product covered operating costs without provisions for depletion, depreciation, or adequate return on capital investment. There were further shut-downs during 1939. Early in May the American Zinc Lead & Smelting Co. notified its employees

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of its intention to discontinue operation of the slab-zinc division of its East St. Louis smelter, probably before the end of the second quarter of the year. It was stated that this would be the first time that this division has been entirely closed since it was built and put into operation in 1914. According to the company this action was predicated on increased operating costs brought about in the last 3 years by the increased costs of labor, fuel, supplies, and taxes, which make it impossible to operate under current prices for zinc. Later in May, the United Zinc Co., Moundsville, W. Va., announced that effective June 1 a 10-percent cut in salaries and wages would be imposed because of the serious financial condition of the company. According to press reports the workers declined to accept the cut, preferring to go into an unemployed status. The plant was closed on June 1 for an indefinite period.

Import statistics for the first 4 months of 1939 indicate that the quantity of slab zinc entered for consumption totaled 9,350 tons compared with 1,782 tons in the same period of 1938. Information is not available as to how much of this metal eventually will be exported in manufactures with benefit of draw-back. Nevertheless, the large increase in imports in 1939 suggests that substantial quantities of foreign zinc may be invading domestic markets.

The foregoing analysis of the zinc industry indicates clearly that domestic producers are confronted with a critical situation as a result primarily of unsatisfactory conditions abroad. Their effects on the domestic market have been intensified by the 20-percent reduction in tariff.

Since the terms of the Canadian Trade Agreement were made public, representatives of the zinc industry have protested vigorously the reduction in the duty on zinc and have urged the Government to restore the tariff to its former level. This can be accomplished either by the State Department or by Congress. The State Department could initiate action under the provision in the trade agreement that gives each country the right to withdraw or modify the concession granted on any article—

> * * * If, as the result of the extension of such concession to other foreign countries, such countries obtain the major benefit of the concession, and if in consequence imports of the article concerned increase to such an extent as to threaten serious injury to domestic producers.

The State Department has been studying the situation in detail with a view to determining whether the actual effects of the tariff reduction merit such action. Congress could restore the tariff to its former level by legislative enactment, and a bill to do this has been introduced in the present session. It is understood, however, that Congress is reluctant to inaugurate action to restore specific reductions in the various trade agreements by such means as eventually it might vitiate the entire reciprocal-trade-treaty program.

DOMESTIC PRODUCTION

Production of primary and secondary slab zinc.—Production of primary slab zinc from domestic and foreign ores in 1938 declined 20 percent from 1937, was equivalent to 74 percent of the average output for the 5-year period 1925–29, but exceeded by 115 percent the depression low established in 1932.

Production from domestic sources decreased 21 percent, whereas that from foreign sources increased 80 percent. Foreign ores smelted in 1938 were obtained almost entirely from Peru and Mexico.

Production of secondary slab zinc fell off 35 percent from 1937. Statistics on remelted secondary zinc for 1937 have been revised, and those for prior years are being revised because some producers of redistilled metal inadvertently have been reporting their production as remelted metal also. Former statistics on production of remelted zinc thus have overstated the actual output of this type of metal.

Primary and secondary slab zinc produced in the United States, 1934–38, in short tons

Year	Primary			Secondary			Grand total
	Domestic	Foreign [1]	Total	Redistilled	Remelted	Total	
1934	355,366	8,224	363,590	19,691	(2)	(2)	(2)
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	[3] 12,986	[3] 64,540	[3] 621,444
1938	436,007	10,334	446,341	31,613	10,657	42,270	488,611

[1] All foreign zinc smelted in the United States in 1934–36 was derived from Mexican ores; in 1937–38, most of it originated in Peru.
[2] Figures in process of revision.
[3] Revised figures.

Distilled and electrolytic zinc.—Of the total output of primary zinc in 1938, 79 percent was distilled and 21 percent electrolytic. Production of distilled primary zinc declined 20 percent and that of electrolytic zinc 21 percent. The production of redistilled secondary zinc dropped 39 percent; large decreases occurred at both primary and secondary smelters.

Distilled and electrolytic zinc, primary and secondary, produced in the United States, 1934–38, in short tons

APPORTIONED ACCORDING TO METHOD OF REDUCTION

Year	Electrolytic primary	Distilled primary	Redistilled secondary [1]		Total
			At primary smelters	At secondary smelters	
1934	76,657	286,933	4,962	14,729	383,281
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

APPORTIONED ACCORDING TO GRADE

Year	Grade A (high-grade)	Grade B (intermediate)	Grade C (brass special)	Grade D (selected)	Grade E (prime western)	Total
1934	116,720	32,621	43,657		190,283	383,281
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

[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 producer of primary slab zinc, Montana replaced Oklahoma in second place, and Illinois again ranked fourth. The output of West Virginia and Texas is shown under "Other States." Production from all States decreased in 1938. All the production in Montana and Idaho is electrolytic zinc, whereas the other States shown produce only distilled zinc.

Primary slab zinc produced in the United States, by States, 1934–38, in short tons

Year	Arkansas	Idaho	Illinois	Montana	Oklahoma	Pennsylvania	Other States [1]	Total: Short tons	Total: Value
1934	11,808	9,935	55,773	66,722	61,711	100,728	56,913	363,590	$31,269,000
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

[1] Texas and West Virginia.

Secondary zinc.—Besides the redistilled and remelted secondary slab zinc (unalloyed) mentioned previously, a large quantity of secondary zinc is recovered each year in the form of alloys, zinc dust, zinc pigments, and zinc salts. Details are given in the chapter on Secondary Metals—Nonferrous.

Byproduct sulfuric acid.—An important byproduct of zinc smelting is sulfuric acid made from the sulfur dioxide gases evolved from the roasting of zinc blende. Some plants also consume large quantities of sulfur in addition to blende to utilize a larger proportion of their acid-producing capacity. The following table shows the production of sulfuric acid at zinc-blende roasting plants from 1933 to 1937. Data for 1938 are not yet available.

Sulfuric acid (60° B. basis) made at zinc-blende roasting plants in the United States, 1933–37 [1]

Year	Made from zinc blende: Short tons	Made from zinc blende: Value [2]	Made from sulfur: Short tons	Made from sulfur: Value [2]	Total: Short tons	Total: Value [2]: Total	Total: Value [2]: Average per ton
1933	355,027	$2,676,904	242,493	$1,828,397	597,520	$4,505,301	$7.54
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

[1] Figures for 1938 not yet available.
[2] At average of sales of 60° acid.
[3] Includes acid from small quantity of foreign blende.

Rolled zinc.—Production of rolled zinc in 1938 decreased 21 percent from 1937. Some producers fabricate their rolled zinc into various products, and the scrap resulting from these operations is remelted and rerolled. In 1938 the scrap so treated amounted to 9,392 tons compared with 11,062 in 1937. Zinc lost in waste products, such as skimmings and drosses and pot losses, totaled 1,150 tons in 1938—equivalent to about 3 percent of the net production of rolled zinc. Of the zinc purchased for rolling in 1938, 38 percent was brass special, 32 percent prime western, 14 percent selected, 14 percent high grade, and 2 percent electrolytic and intermediate grades. Stocks of slab zinc on hand at zinc-rolling mills were about 9,600 tons at the beginning and about 7,600 tons at the end of the year.

Rolled zinc produced and quantity available for consumption in the United States, 1937–38

	1937			1938		
	Short tons	Value		Short tons	Value	
		Total	Average per pound		Total	Average per pound
Production:						
Sheet zinc not over 0.1 inch thick	15,489	$3,604,000	$0.116	12,219	$2,503,000	$0.102
Boiler plate and sheets over 0.1 inch thick	1,223	228,000	.093	829	145,000	.087
Strip and ribbon zinc [1]	41,384	7,434,000	.090	32,827	5,278,000	.080
Total zinc rolled [1]	58,096	11,266,000	.097	45,875	7,926,000	.086
Imports	231	30,000		226	26,000	
Exports	5,813	1,104,000	.095	[2] 5,736	[2] 908,000	.079
Available for consumption	52,514			40,365		
Value of slab zinc (all grades)			.065			.048
Value added by rolling			.032			.038

[1] Figures represent net production. In addition, 11,062 tons of strip and ribbon zinc in 1937 and 9,392 tons of strip and ribbon zinc in 1938 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.—The output of zinc dust decreased 24 percent from 1937, the peak year. The zinc content of dust produced in 1938 ranged from 94 to 98.5 percent and averaged 97 percent. Since 1931 virtually all zinc dust has been produced by redistillation of zinc drosses and slab zinc.

Zinc dust [1] produced in the United States, 1934–38

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average per pound			Total	Average per pound
1934	10,856	$1,342,133	$0.062	1937	15,242	$2,587,577	$0.085
1935	12,453	1,574,259	.063	1938	11,609	1,542,511	.066
1936	14,425	1,957,300	.068				

[1] All produced by distillation.

Zinc pigments and salts.—Zinc oxide, leaded zinc oxide, and lithopone are the principal pigments of zinc and chloride and sulfate the principal salts. 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 decreased 18 percent in 1938. The Western States suffered the largest decline in both tonnage and percentage, the latter amounting to 25 percent. The reduction in tonnage in the Central States was almost as large, a 19-percent drop in output being recorded. Production in the Eastern States declined only 9 percent; declines in New Jersey and New York were offset in part by increases in Virginia and Tennessee.

Of interest in the Western States are the gains in Washington and New Mexico. The gain in Washington resulted from increased production at two mines in the Metaline district, one of which shut down about midyear after having begun production only in October 1937. New Mexico's increase was due mostly to expanded production in the Central district. Arizona and Colorado recorded smaller increases, but all other States showed major declines.

In the Central States the Tri-State region produced 17 percent less zinc in 1938 than in 1937. The output in 1938 was equivalent to only 55 percent of the average yearly output from 1925 to 1929. The district supplied 38 percent of the total zinc produced in the United States in 1938 compared with 49 percent in the predepression 5-year period, 1925–29. The marginal nature of production in Wisconsin is indicated by the 70 percent decline in that State.

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 1934–38, in short tons

State	1925–29 (average)	1934	1935	1936	1937	1938
Western States:						
Arizona	2,628	905	3,337	3,589	5,026	5,814
California	3,999	361	161	8	20	------
Colorado	32,868	772	1,202	1,172	4,247	4,553
Idaho	29,128	24,799	31,053	49,100	54,199	44,030
Montana	72,519	30,721	54,781	49,717	39,168	8,844
Nevada	5,570	13,940	15,536	13,477	14,236	8,940
New Mexico	23,351	26,522	22,126	20,668	23,927	28,236
Oregon	------	37	------	61	24	------
Utah	44,385	28,198	31,107	36,192	48,001	33,658
Washington	575	1,926	1	4,403	4,116	11,402
	215,023	128,181	159,304	178,387	192,964	145,477
Central States:						
Arkansas	71	68	153	182	241	152
Illinois	1,174	------	------	------	------	------
Kansas	114,323	38,261	54,110	79,017	80,300	73,024
Kentucky	644	125	127	238	270	322
Missouri	16,708	7,059	7,263	18,709	20,600	10,226
Oklahoma	226,969	107,772	129,763	129,175	135,696	112,924
Wisconsin	23,055	9,807	8,923	8,126	6,938	2,073
	382,944	163,092	200,339	235,447	244,045	198,721
Eastern States:						
New Jersey	93,839	76,553	85,708	89,883	101,408	85,839
New York	7,091	23,188	23,720	26,941	32,690	29,896
Tennessee and Virginia [1]	25,823	47,712	48,832	44,916	55,255	56,766
	126,753	147,453	158,260	161,740	189,353	172,501
	724,720	438,726	517,903	575,574	626,362	516,699

[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, 1934–38, in short tons

District	State	1934	1935	1936	1937	1938
Joplin region	Kansas, Missouri, Oklahoma	153,092	191,136	226,857	236,585	196,174
New Jersey	New Jersey	76,553	85,708	89,883	101,408	85,839
Eastern Tennessee	Tennessee	47,712	48,832	44,916	55,255	56,766
Austinville	Virginia					
Coeur d'Alene region	Idaho	24,799	31,009	44,310	47,070	31,937
St. Lawrence County	New York	23,188	23,720	26,941	32,690	29,896
Bingham	Utah	16,611	17,996	17,422	20,570	23,096
Central	New Mexico	9,109	8,404	10,706	11,887	16,695
Warm Springs	Idaho		39	4,771	6,959	12,070
Metaline	Washington	1,926		4,389	4,095	11,402
Willow Creek	New Mexico	16,847	13,372	9,667	10,882	11,291
Pioche	Nevada	11,196	12,183	12,047	12,472	8,414
Smelter	Montana	6,732	11,078	7,986	10,330	6,063
Park City region	Utah	9,693	9,659	13,579	19,342	5,678
San Juan Mountains	Colorado	125	153	140	2,092	4,308
Oro Blanco	Arizona	900	3,270	3,065	2,700	3,265
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	9,807	8,923	8,126	6,938	2,073
Rush Valley	Utah	859	981	1,366	2,205	1,955
Ophir	do	920	2,167	3,563	4,023	1,893
Wallapai	Arizona	5	67	524	1,714	1,660
Summit Valley (Butte)	Montana	21,165	37,646	34,940	22,033	942
Tintic	Utah	9	15	177	1,259	921
Cataract	Montana	212	1,029	1,354	1,043	605
Flint Creek	do	2,216	4,746	4,307	4,641	426
Leadville	Colorado	515	924	871	1,676	97
Tybo	Nevada	(1)	(1)	(1)	1,417	

1 Bureau of Mines not at liberty to publish figures.

STOCKS

Total stocks of slab zinc were 97 percent higher at the end than at the beginning of 1938, and year-end inventories on December 31, 1938, were the highest since 1930. Metal on hand at primary reduction plants increased 99 percent, while that at secondary distilling plants decreased 3 percent. Total stocks at the end of 1938 included 75,864 tons of the higher grades of zinc (A and B) and 83,562 tons of the lower grades (C, D, and E) compared with 36,996 and 44,117 tons, respectively, at the end of 1937.

According to the American Zinc Institute zinc stocks reached a peak at the end of June 1938 which was greater than the depression high established near the close of 1930. In the succeeding 5 months, however, shipments to consumers improved. Inventories declined steadily but in December rose substantially as demand fell and production increased.

Stocks of zinc on hand at zinc-reduction plants in the United States at end of year, 1934–38, in short tons

	1934	1935	1936	1937	1938
At primary reduction plants	124,783	90,539	55,500	79,144	157,511
At secondary distilling plants	2,685	1,151	626	1,969	1,915
	127,468	91,690	56,126	81,113	159,426

Stocks of zinc ore in the Tri-State district showed a net decline for 1938. On January 1 about 15,000 tons of concentrates (sold and unsold) were on hand with an estimated recoverable zinc content of 8,000 tons. In the spring months demand for ore was sharply curtailed as stocks of metal at smelters mounted rapidly. By July 2 ore on hand reached a peak for the year of 27,000 tons, equivalent to about 14,000 tons of metal, but in the remaining 6 months ore shipments were considerably higher, and at the close of the year stocks were only 8,400 tons of ore, equivalent to 4,400 tons of metal.

O. W. Roskill, of London, in his review of the European and world zinc situation in 1938 at the annual meeting of the American Zinc Institute, Inc., at St. Louis in April 1939, estimated producers' stocks of metallic zinc outside the United States at 195,000 to 210,000 metric tons at the beginning of 1938 and 270,000 to 280,000 tons at the end. On this basis world stocks may be estimated to have increased from a maximum of about 310,000 short tons on January 1 to a maximum of 470,000 tons on December 31, 1938. The Consolidated Mining & Smelting Co. of Canada, Ltd., in its annual report for 1938, estimated world stocks at 300,000 short tons at the end of 1937 and 425,000 tons at the end of 1938. In addition large stocks of concentrates are held by European smelters and various mining companies throughout the world.

DOMESTIC CONSUMPTION

New supply.—The supply of new zinc available for consumption in 1938 decreased 34 percent from 1937. Declines of 41, 24, and 48 percent, respectively, were recorded for copper, lead, and pig iron. Compared with 1925–29 averages, apparent consumption of zinc in 1938 dropped only 32 percent, whereas that of copper, lead, and pig iron decreased 48, 51, and 52 percent, respectively.

Primary slab zinc available for consumption in the United States, 1934–38, in short tons

	1934	1935	1936	1937	1938
Supply:					
Stock at smelters Jan. 1	110,487	124,783	90,539	55,500	79,144
Production	363,590	420,634	492,132	556,904	446,341
Imports	1,725	4,444	11,660	37,208	7,230
Total available	475,802	549,861	594,331	649,612	532,715
Withdrawn:					
Exports	5,105	1,617	37	249	[1] 200
Stock at smelters Dec. 31	124,783	90,539	55,500	79,144	157,511
Total withdrawn	129,888	92,156	55,537	79,393	157,711
Available for consumption	345,914	457,705	538,794	570,219	375,004

[1] Not separately recorded; estimated.

Industrial use of slab zinc.—In addition to the new supply noted in the preceding table, a large tonnage of secondary zinc is available each year for industrial use. The American Bureau of Metal Statistics estimates the total industrial use of primary and secondary zinc during the past 5 years as follows:

Estimated industrial use of zinc in the United States, 1934–38, in short tons [1]

Purpose	1934	1935	1936	1937	1938
Galvanizing:					
Sheets	83,300	110,000	132,000	135,000	108,500
Tubes	22,000	25,000	36,000	37,000	29,300
Wire	20,000	25,000	30,000	33,000	23,600
Wire cloth	4,000	5,000	6,000	7,000	5,600
Shapes [2]	22,700	30,000	38,000	40,000	31,000
	152,000	195,000	242,000	252,000	198,000
Brass making	98,000	124,000	165,000	169,000	102,000
Rolled zinc	40,900	56,500	55,000	58,000	46,000
Die castings	32,000	55,500	72,000	88,000	48,000
Other uses [3]	37,000	42,000	48,000	39,000	27,000
	359,900	473,000	582,000	606,000	421,000

[1] Year Book, American Bureau of Metal Statistics, 1938.
[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, and sundries.

The industrial use of zinc in 1938 was 31 percent lower than in 1937 and equivalent to only 66 percent of the record established in 1929. All four major uses of zinc decreased in 1938; die casting 45 percent, brass making 40 percent, and galvanizing and rolled zinc 21 percent each. Galvanizing took 47 percent of the total tonnage used in 1938 compared with 42 percent in 1937. The totals for this item include zinc used in electrogalvanizing and sheridizing. The former decreased from 5,443 tons in 1937 to 3,978 in 1938 and the latter from 701 to 264 tons.

Zinc used in rolled products in 1938 (1937 figures in parentheses) included 15,300 tons (18,500) in battery cans, 15,000 (17,000) in glass-jar tops, 2,000 (6,000) in automobile manufacture, 4,000 (4,750) in photoengraving sheet, 830 (1,200) in boiler plate, 270 (625) in brake lining, and 300 (400) in electric refrigerators. The remaining tonnages were employed for various other uses or exported.

The principal item included in "Other uses" is the slab zinc used in the manufacture of French-process zinc oxide which amounted to about 16,000 tons in 1938 compared with about 24,000 tons in 1937.

PRICES

The downward trend in prices that was evident in the last quarter of 1937 continued the first half of 1938. From 5.00 cents at the beginning of the year, the St. Louis quotation for prime western metal gradually declined to 4.00 cents early in April as consumer interest waned and stocks mounted. Following announcement of the Administration's spending program to revive business there was a brief flurry upward, but by May 10 the price had settled again to 4.00 cents, the low for the year, where it remained until the latter part of June. At this time buying improved, and by July 1 the quotation had risen to 4.75 cents. Despite reductions in producers' stocks in July and August no further change occurred until the middle of September, when quotations again began moving upward. The high for the year, 5.05 cents, was established on October 13 and maintained through November 18, when the price was reduced to 4.75 cents over the week-end following the announcement of the 0.35 cent per pound tariff cut as a result of the Canadian Trade Agreement. Although the reduced tariff was not effective until January 1, 1939, the cut in price at this time, according to trade reports, was a protective measure to discourage domestic consumers from contracting for forward metal from foreign producers. A further reduction to 4.50 cents took place on November 29, and this price level was held throughout December. The average for the year, 4.61 cents, was 29 percent below the average for 1937.

In London the decline in prices was more pronounced than in domestic markets, the average for 1938 having decreased 38 percent from that for 1937. The differential between New York and London increased from 1.49 cents per pound in April to 2.28 cents in November. At the close of the year the differential was 1.98 cents. The average differential for 1938 was 1.94 cents compared with 1.96 in 1937.

The trends in the New York and London prices during the last half of November are of interest in view of the sudden announcement on November 18 of the impending reduction in the United States import duty. From November 15 to 18 the differential rose from 2.42 to 2.46 cents, but after the sharp reduction in domestic prices on November 21 it fell to 2.19 cents. The following day the London quotation dropped 6 points bringing the differential back to 2.25 cents. On November 23 the foreign price recovered 5 points to 2.20 cents below the New York price. It then moved to lower levels and on November 28 was 2.29 cents under the New York quotation. Following the 0.25-cent cut in domestic prices on November 29, the differential declined to 2.05 cents and then to 1.98 cents on November 30, as London prices recorded a 0.07-cent advance.

Price of zinc and zinc concentrates, 1934–38

	1934	1935	1936	1937	1938
Average price of common zinc at—					
St. Louis (spot) .... cents per pound..	4.16	4.33	4.90	6.52	4.61
New York .... do....	4.51	4.70	5.28	6.87	4.99
London .... do....	3.07	3.08	3.31	4.91	3.05
Excess New York over London .... do....	1.44	1.62	1.97	1.96	1.94
Joplin 60-percent zinc concentrates:					
Price per short ton .... dollars..	27.14	28.81	31.95	39.87	27.83
Price of zinc content .... cents per pound..	2.26	2.40	2.66	3.32	2.32
Smelter margin .... do....	1.90	1.93	2.24	3.20	2.29
Price indexes (1925–29 average=100):					
Zinc (New York)	63	66	74	97	70
Lead (New York)	52	54	63	80	63
Copper (New York)	58	59	65	90	68
Nonferrous metals [1]	68	69	72	91	74
All commodities [1]	76	81	82	88	80

[1] Based on 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, 1937–38 [1]

Month	1937			1938		
	60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)		60-percent zinc concentrates in the Joplin region (dollars per ton)	Metallic zinc (cents per pound)	
		St. Louis	London		St. Louis	London
January	35.65	5.86	4.63	29.13	5.00	3.34
February	39.99	6.43	5.49	28.17	4.82	3.23
March	44.81	7.38	7.24	27.28	4.41	3.20
April	44.72	6.99	5.75	26.04	4.15	3.05
May	41.16	6.75	5.09	25.43	4.04	2.81
June	41.16	6.75	4.72	25.43	4.14	2.85
July	41.39	6.93	5.00	27.75	4.75	3.11
August	42.76	7.20	5.37	27.75	4.75	2.93
September	43.47	7.18	4.73	27.75	4.85	3.01
October	38.75	6.09	3.92	29.47	5.01	3.21
November	33.76	5.63	3.52	30.56	4.91	3.02
December	29.40	5.01	3.41	27.16	4.50	2.86
Average for year	39.87	6.52	4.91	27.83	4.61	3.05

[1] All quotations from Metal Statistics, 1939. Conversion of English quotations into American money based on average rates of exchange recorded by the Federal Reserve Board of the Treasury.

Average price of zinc received by producers, 1934–38, by grades, in cents per pound

	1934	1935	1936	1937	1938
Grade A (high grade)[1] Grade B (intermediate)	4.50	4.55	5.15	6.65	5.03
Grades C and D (select and brass special)[1]	4.10	4.31	4.91	6.47	4.73
Grade E (prime western)	4.15	4.32	4.89	6.44	4.71
All grades	4.3	4.4	5.0	6.5	4.8
Prime western; spot quotation at St. Louis	4.2	4.3	4.9	6.5	4.6

[1] American Metal Market quotes average prices of high grade and brass special as follows: High grade (f. o. b. New York), 1934, 5.24 cents; 1935, 5.33 cents; 1936, 5.90 cents; 1937, 7.76 cents; 1938, 5.74 cents; brass special (f. o. b. East St. Louis), 1934, 4.23 cents; 1935, 4.41 cents; 1936, 4.98 cents; 1937, 6.62 cents; 1938, 4.71 cents.

ZINC-REDUCTION PLANTS

Zinc smelters.—At the close of 1938 there were 19 primary zinc-distillation plants in the United States—17 active during the year and 2 idle. Except for 224 retorts added to existing blocks at the Bartlesville plant no new capacity was installed in 1938. The Van Buren plant, which had been idle since 1927 and was rehabilitated and put into operation during 1937, was active part of 1938, but was idle at the end of the year. Of the 17 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, and 33,949 were in use at the end of the year. In addition, 46 of the 52 installed vertical retorts were operating at the close of 1938.

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., and Tottenville, N. Y., operate exclusively on scrap.

The Torrance (Calif.) plant of Pacific Smelting Co., Ltd., contains small clay retorts as well as large graphite retorts for treating secondary materials. W. J. Bullock is operating a new large graphite-retort plant at Fairfield, Ala.

Electrolytic plants.—The Evans-Wallower Zinc Co. plant at East St. Louis continued idle in 1938 despite rumors that it was to be reopened. The Anaconda and Great Falls (Mont.) plants of the Anaconda Copper Mining Co. operated at greatly reduced capacity in 1938. Both plants were closed during part of January and February. The Kellogg plant of the Sullivan Mining Co. completed a 50-percent increase in plant capacity in 1938. Two of the three units were operated during the first quarter of 1938, but only one unit was used the remainder of the year. At the three active plants 1,460 cells out of a total of 2,192 were in use at the end of 1938.

TECHNOLOGY

Despite market conditions in 1938, which hardly warranted expenditures for improving plants and technique, there were several interesting developments in technology.

Mining.—The practice of replacing ore pillars with concrete now being developed in the Southeast Missouri lead district is being considered in the Tri-State area, where pillars constitute 7 to 10 percent of the mineralized areas. The D. C. & E. mine at Oronogo, Mo., has been completely mechanized on an experimental basis, using scrapers, conveyers, skips, and other modern equipment; mining costs are reported to be half the average of the district. Development work at the Grasselli mine, New Market, Tenn., which began production in 1937, consisted largely of preparation for mill-hole and slusher hoist operations.

Milling.—The heavy-density cones at Mascot, Tenn., continued to operate satisfactorily throughout 1938. Additional equipment, installed to increase capacity, resulted in decreased milling costs and higher recoveries. Experimentation with a similar process continued at the Central mill of the Eagle-Picher Mining & Smelting Co., Picher, Okla. In the western lead-zinc areas Engelmann [2] reports that minerec "A" is used in 80 percent of the plants where it has partly or completely replaced xanthate in the lead circuits. Sodium Aerofloat is used extensively as a zinc promoter. He also states that the Fagergren flotation machine is finding favor with lead-zinc operators.

Reduction.—Aside from the 224 retorts added to existing furnaces at Bartlesville, no new domestic smelting capacity was built in 1938. Sinn [3] reports that outputs per retorts and recoveries have been improved at domestic horizontal-retort smelters. In European plants larger retorts are being used; daily production of more than 70 pounds of zinc per retort is common practice at 90 percent or better recovery, and 90-pound outputs are being considered. Because of the superior quality of European clays, which permits higher temperatures, it is possible to use larger retorts in Europe than in the

[2] Engelmann, E.W., Ore Concentration and Gold Milling: Min. and Met., vol. 20, No. 385, January 1939, pp. 13–14.

[3] Sinn, Francis P., Metallurgy of Zinc: Min. and Met., vol. 20, No. 385, January 1939, pp. 18–19.

United States. Prolongs also are used in European plants, and American producers probably lose at least 5 percent of their zinc by not following European practice in this respect. General progress in process improvement was reported by the large vertical-retort smelters and the electrothermic smelting plant at Josephtown, Pa. Two additional Waelz kilns were constructed, making a total of eight in use at retort smelters and zinc oxide plants in the United States.

The 50-percent addition to the electrolytic zinc plant in Idaho was put into production in 1938, but this plant as well as those at Anaconda and Great Falls, Mont., operated at only partial capacity throughout the year. Emphasis is being placed on increasing the production of 99.99+ percent metal. Electrogalvanizing of wire is progressing, and production of sheets by the same process is being considered. New electrolytic zinc plants are planned for Yugoslavia, Rumania, and Peru, and the feasibility of another in Quebec for treating Noranda and other ores is being investigated.[4]

FOREIGN TRADE[5]

Imports.—The following tables give zinc imports into the United States, 1934–38, inclusive, and a record of bonded-warehouse inventories.

Zinc ores (zinc content) imported into the United States, 1934–38, in short tons [1]

Year	Canada	Mexico	Other countries	Total	Year	Canada	Mexico	Other countries	Total
1934	(2)	14,277	(2)	14,277	1937	84	338	[3] 8,390	8,812
1935		10,520		10,520	1938		7,253	[3] 11,330	18,583
1936		172		172					

[1] Data include ore imported for immediate consumption plus material entering the country under bond.
[2] Less than 1 ton.
[3] Includes 8,373 tons imported from Peru in 1937; all from Peru in 1938.

Zinc [1] *remaining in warehouse in the United States, December 31, 1934–38*

Year	*Pounds*	Year	*Pounds*
1934	14,354,435	1937	24,904,405
1935	13,840,586	1938	51,058,378
1936	10,690,832		

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

Imports of zinc ore in 1938 increased 111 percent over 1937 owing to large increases in shipments from Mexico and Peru. Those of slab zinc decreased 81 percent from 1937, the peak year. Of the 7,230 tons received, Mexico furnished 3,346, Canada 2,332, Poland and Danzig 1,210, Belgium 286, and other British South Africa 56.

[4] Shelton, S. M., and Duncan, W. E., Zinc Metallurgy Is Far from Static: Eng. and Min. Jour., vol. 140, No. 2, February 1939, pp. 81–82.

[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.

Zinc imported for consumption in the United States, 1934–38

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		
1934	1,725	$112,923	55	$6,978	--------	--------	18	$1,395	$8,523	$129,819
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

[1] Includes dross and skimmings: 29 tons valued at $974 in 1935; 15 tons valued at $721 in 1936; and 560 tons valued at $59,635 in 1937. No imports reported in 1938.

Exports.—The total value of the 1938 exports of zinc ore and manufactured articles containing zinc of foreign and domestic origin (excluding galvanized products, alloys, and pigments) was approximately $1,271,000, a decrease of 18 percent from 1937. Exports of plates, sheets, pigs, and slabs decreased 5 percent, while those of zinc dust increased 5 percent in quantity but decreased 15 percent in value. Besides 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 13,300 tons of zinc were exported in galvanized products in 1938 compared with 13,900 tons in 1937. Export data on zinc pigments and chemicals are given in the chapter on Lead and Zinc Pigments and Zinc Salts in this volume. Much of the zinc used in the manufacture of these products is of foreign origin, and when it is exported a draw-back is paid amounting to 99 percent of the import duty. In 1938 draw-back was paid on 11,550 tons of zinc, of which 7,989 tons had been imported as slabs and 3,561 tons as ore. Totals for previous years were: 1937, 9,253; 1936, 8,909; 1935, 7,297; and 1934, 4,139.

Zinc ore and manufactures of zinc exported from the United States, 1934–38

Year	Zinc ore, concentrates, and dross (zinc content)		Pigs or slabs		Plates and sheets		Zinc dust	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	3,621	$157,419	5,105	$284,023	3,462	$569,208	1,489	$223,868
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

[1] Pigs and slabs not shown separately; included with plates and sheets.

Slab and sheet zinc exported from the United States, 1935–38, by destinations, in short tons

Destination	Slabs, blocks, or pigs				Sheets, strips, etc.			
	1935	1936	1937	1938	1935	1936	1937	1938
Countries:								
Canada	5	5	1	(1)	2,159	1,999	2,251	2,317
Chile	7	7	65	(1)	2	6	1	9
France	--------	--------	125	(1)	12	3	(2)	--------
Germany	72	--------	--------	(1)	8	4	2	13
India, British	1,121	--------	--------	(1)	2	3	90	110
Japan	--------	1	--------	(1)	191	199	194	232
United Kingdom	1	--------	23	(1)	1,367	1,048	849	775
Others	411	24	35	(1)	1,072	1,221	2,426	2,280
Total	1,617	37	249	(1)	4,813	4,483	5,813	5,736
Continents:								
North America	43	19	10	(1)	2,379	2,164	2,413	2,527
South America	21	10	72	(1)	285	244	409	643
Europe	425	--------	148	(1)	1,587	1,151	922	914
Asia	1,128	8	19	(1)	382	678	1,010	673
Africa	--------	--------	--------	(1)	15	1	82	107
Oceania	(1)	--------	--------	(1)	165	245	977	872

1 Slabs, blocks, or pigs not shown separately; included with sheets, strips, etc.
2 Less than 1 ton.

WORLD ASPECTS OF ZINC INDUSTRY

Cartel activities.—Efforts to reconstitute the International Zinc Cartel which collapsed in 1934 were stimulated in 1938 by declining prices and mounting stocks of ore and metal but without success. Among the unsurmountable obstacles is the nationalistic policy of Germany and Italy, who refuse to consider any curtailment of output within their confines, despite its uneconomic character. The agitation for a large increase in the British tariff on zinc, designed to exclude non-British zinc from the United Kingdom, was another barrier. Still another obstacle, pointed out by Roskill,[6] is the apathy of custom smelters and ore producers toward cutailment of production. The custom smelter is more interested in treating a large volume of ore on a per-ton basis than in maintaining prices. Although this is a short-sighted policy and in the long run is detrimental to the best interests of the custom smelter, it undoubtedly prevails at present because the future of international relations is so uncertain. The producer's attitude is due to the byproduct nature of zinc, and mine operators are disposed to maintain lead and silver production schedules without regard to the resulting overproduction of zinc. The present outlook for international cooperation in the slab-zinc industry certainly cannot be considered hopeful.

In February 1938 an International Zinc Sheet Cartel was formed and eventually included producers in 10 countries—the United Kingdom, Belgium, the Netherlands, Germany, France, Spain, Hungary, Poland, Yugoslavia, and Czechoslovakia. Italy was not included, but Belgian control of Italian rolling mills was expected to prevent any disturbing influence from this source.

World production.—World production of zinc (smelter basis) decreased 4 percent from the record established in 1937. This decline

6 Roskill, O. W., Lead, Zinc, and Cadmium in 1938: Min. Jour., London, vol. 204, No. 5402, Mar. 4, 1939, pp. 169–171.

was due entirely to the 20-percent drop in United States production, as the total output elsewhere increased 4 percent to a new all-time peak. Compared with 1929, production in the United States in 1938 decreased 29 percent, whereas that of the rest of the world increased 30 percent. The United States proportion of the world total was 39 percent in 1929, 31 percent in 1937, and only 26 percent in 1938. There were also notable declines in output in Belgium, Italy, Northern Rhodesia, and the United Kingdom and substantial increases in Canada, Germany, Japan, Norway, and the U. S. S. R. in 1938.

World smelter production of zinc, 1934–38, in metric tons, by countries where smelted

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Australia	55,506	68,752	71,641	70,869	70,941
Belgium	174,900	181,740	195,320	217,750	209,983
Canada	122,394	135,645	137,078	143,826	155,973
Czechoslovakia	7,616	9,648	7,670	7,336	8,876
France	47,248	47,443	51,694	60,427	60,560
Germany [1]	71,196	123,198	133,427	163,814	192,000
Indochina	4,240	3,837	4,112	4,204	4,447
Italy	24,864	27,579	27,025	37,982	34,065
Japan	32,145	34,191	39,066	45,500	[2] 50,000
Mexico	29,148	32,327	31,913	36,587	35,881
Netherlands	19,911	13,747	15,428	24,645	25,300
Northern Rhodesia	19,854	21,012	21,063	14,256	10,379
Norway	45,027	45,019	45,028	41,276	46,500
Poland	92,921	84,606	92,580	107,174	108,071
Spain	8,184	7,648	7,803	5,279	7,672
U. S. S. R.	27,084	47,910	66,000	[2] 65,000	[2] 70,000
United Kingdom [1]	52,022	61,433	61,768	63,138	56,190
United States	329,842	381,591	446,452	505,212	404,912
Yugoslavia	4,037	3,356	3,599	5,012	5,956
	1,168,000	1,331,000	1,459,000	1,619,000	[2] 1,558,000

[1] Some secondary material included. [2] Approximate production.

World consumption.—World consumption of slab zinc, according to the American Bureau of Metal Statistics, amounted to 1,487,000 metric tons, 9 percent less than in 1937. Consumption in the United States decreased 33 percent, whereas that of the rest of the world increased 3 percent and established a new peak. The international armament race continues to play an important part in maintaining consumption abroad, and undoubtedly some nations are accumulating war stockpiles of zinc. Zinc consumption in the United States in 1938 declined 31 percent compared with 1929, but that elsewhere rose 20 percent.

The United States again ranked first in zinc consumption, taking 25 percent of the total. Germany ranked second with 18 percent, and the United Kingdom third with 14 percent. Belgium used 7 percent, France and Japan each 6, and U. S. S. R. 5 percent. Of the foregoing countries, Germany, U. S. S. R., Japan, and Belgium used 11, 11, 6, and 2 percent more zinc than in 1937, respectively, whereas the United Kingdom and France used 9 and 3 percent less, respectively.

REVIEW BY COUNTRIES

Australia.—The electrolytic zinc plant at Risdon continued capacity operation in 1938. Approximately one-third of the product is obtained from Tasmanian ores and two-thirds from Broken Hill ores.

In the Broken Hill district interest centered in the development of the New Broken Hill mine, which is expected to begin production in 1940, and exhaustion of the Broken Hill Proprietary mine, which closed early in February 1939. The latter began operations in 1885 and has produced 12,300,000 long tons of ore yielding 1,445,000 tons of lead, 189,457,000 ounces of silver, and 603,000 tons of zinc. At North Broken Hill the new concentrator, capacity 50,000 tons per month, was placed in operation April 11, 1939. The Zinc Corporation continued the enlargement of its mill and surface equipment in anticipation of treating the ore from the adjoining New Broken Hill mine; a new shaft is being sunk that will serve both mines. Crude-ore production of the district was approximately 1,545,000 tons, an increase of 77,000 tons over 1937.

Mt. Isa made a profit of £19,742 in the year ended June 30, 1938, compared with £70,309 in the previous year. In the last fiscal year 609,377 tons of ore were produced, of which 594,752 tons were milling ore containing 9.8 percent zinc, 8.9 percent lead, and 7.3 ounces of silver per ton. Ore reserves were estimated at 9,354,500 tons. Milling methods and costs have been described by Kruttschnitt [7] and others.

The Lake George mine began production in January 1939 when the first 500-ton-per-day unit of the concentrator was started. Another 500-ton unit is contemplated.

Total mine production of zinc in Australia was estimated at 178,500 tons in 1938. Exports of metallic zinc totaled 38,000 tons compared with 39,500 tons in 1937. Nearly 194,000 tons of concentrates were shipped abroad in 1938 as against 187,000 tons in 1937.

Belgium.—Imports of zinc ore totaled 537,000 metric tons in 1938, a decline of 13 percent from 1937. Mexico supplied 27 percent of the total. Other important sources were British India, Sweden, Yugoslavia, Canada, Newfoundland, Australia, Italy, and Spain. Receipts from Spain and Italy increased, but those from the other countries decreased. Exports of slab zinc declined from 151,000 to 130,000 tons; shipments to the United Kingdom decreased, while those to Germany increased. Exports of zinc sheets and wire dropped from 47,000 to 38,000 tons. Imports of slab zinc were reduced from 24,000 to 14,000 tons. Vieille Montagne produced nearly 110,000 tons of zinc at its various plants in Belgium and elsewhere, 7 percent less than in 1937. The entire reduction was in retort metal, as the output of electrolytic zinc was maintained at full capacity—37,000 tons.

Burma.—The Burma Corporation, Ltd., produced 60,744 long tons of zinc concentrates averaging over 58 percent zinc in 1938, compared with 73,552 tons averaging slightly under 58 percent in 1937. The decline in output was due to the reduced zinc content of the ore mined in 1938. The concentrates are shipped chiefly to Belgium. Imports of slab zinc into British India, used largely in galvanizing, declined from 24,000 to 21,000 tons.

Canada.—Seventy-eight percent of Canada's production of metallic zinc in 1938 was made at Trail and 22 percent at Flin Flon. Both plants increased their output over 1937. Construction of a third

[7] Kruttschnitt, J., Jacobsen, L. K., and Gross, K. B., Milling Methods and Costs of the Mt. Isa Mines, Ltd., Mount Isa, Queensland, Australia: Bureau of Mines Inf. Circ. 7073, 1939, 33 pp.

electrolytic zinc plant has been mentioned as a possibility by the Minister of Mines for Quebec. The plant would provide a market for zinc concentrates from the Waite Amulet, Normetal, Noranda, and Quebec Manitou mines. Shawinigan Water & Power Co. is said to be interested in the project which would be financed by American capital. Reserves of copper-gold-silver-zinc ore at the Waite Amulet property were increased extensively by new discoveries in 1938. Exports of zinc ore from Canada declined from 33,000 to 23,000 short tons, the bulk of which was consigned to Belgium. Exports of slab zinc in 1938 totaled 132,000 tons compared with 134,000 in 1937. The United Kingdom took nearly 100,000 tons and Japan 15,000 tons in 1938; both countries increased their purchases.

France.—Although the smelter output of zinc increased only slightly, imports of zinc ore increased 22 percent. Of the 192,000 metric tons received in 1938, 54,000 came from Mexico, 32,000 from other North America, 23,000 from Turkey, 16,000 from Yugoslavia, 15,000 from Sweden, 12,000 from Italy, and 40,000 from other countries. Exports of zinc ore declined from 55,000 to 38,000 tons; these ores move largely to Norway after removal of the sulfur. France also imports large quantities of slab zinc—32,000 tons in both 1937 and 1938. There is a small subsidized ore production in France and the French colonies.

Germany.—Much of the 17-percent increase in Germany's smelter output in 1938 resulted from enlargement of the Magdeburg electrolytic zinc plant, the annual capacity of which was increased from 40,000 to 60,000 metric tons. Some of the older retort furnaces have been rehabilitated to increase their output. Construction of a second unit of 8 continuously operated vertical retorts at Oker will be completed in 1939, and construction of 16 additional retorts has begun. Two old smelters were acquired with the annexation of Sudeten Czechoslovakia, the production of which has amounted to 7 or 8 thousand tons annually in recent years, largely from imported ore, however. Mine production in Germany made some progress in 1938, and new developments in treating the zinciferous pyrite and cinder at Meggen probably will increase domestic output considerably. Imports of slab zinc increased from 71,000 to 75,000 tons in 1938 and of zinc ore from 146,000 to 185,000 tons. Exports of zinc ore also increased, from 45,000 to 47,000 tons, and those of crude zinc rose from 100 to 6,900 tons.

Indochina.—In view of recent Japanese aggression in southeastern China the zinc production of Indochina is of interest. In 1938, 4,447 metric tons of metallic zinc were produced compared with 4,204 tons in 1937. A smelter at Quang Yen, Tonkin, treats 45-percent concentrates from the mines at Chodien. Virtually all the metal is exported to France. No ore was exported in 1938.

Italy.—Apparently Italy's zinc requirements declined in 1938 as there was a 10-percent reduction in smelter output. Production of zinc ores, however, increased from 182,000 to 202,000 metric tons as a result of the pressure to increase lead production. Exports were well maintained at 74,000 tons, of which a large part went to Belgium, Poland, and France. Italy's foreign trade in metallic zinc is no longer important. The lead-zinc deposits of the Arbus area, Sardinia, have been described by Wright.[8] A new plant for recovering secondary zinc is being erected in Genoa.

Japan.—Publication of official statistics was discontinued in 1937, so details for 1938 are not available. Showa K. K. apparently has decided to build the new electrolytic plant at its Hibi works in Okayama Prefecture. The plant will have a monthly capacity of 500 tons of metal. It is also stated that the company is to mine and smelt 6,000 tons of zinc annually in Chosen. Zinc was reported to be scarce during 1938, and on August 1 official control of supplies was established. Restrictions were placed on the use of zinc for foil or tubes and in alloys for export trade.

Mexico.—Mine production totaled 172,000 metric tons in 1938 compared with 155,000 tons in 1937. Smelter output amounted to only 36,000 tons in 1938, leaving approximately 130,000 tons (260,000 tons of 50-percent concentrates) available for export after allowing 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 1938 were: Belgium 147,000 tons, France 54,000, the United States approximately 15,000, Germany 12,000, the Netherlands 6,000, and Poland 4,000. Mexican trade returns for 1938 report shipments of 5,200 tons of zinc to Japan and 900 tons to Manchuria. The Rosita smelter experienced labor troubles the latter part of the year.

Newfoundland.—Production of zinc concentrates totaled 122,000 short tons in 1938 compared with 120,000 tons in 1937. The 1938 product contained 63,000 tons of zinc and 470,000 ounces of silver. Lead and copper concentrates contained an additional 11,000 tons of zinc.

Peru.—The Cerro de Pasco Copper Corporation has been considering construction of an electrolytic zinc plant in Peru for several years. Apparently the project finally has been approved, as the president of the company stated at the stockholders' meeting in May 1938 that $3,500,000 to $4,500,000 was to be spent for this purpose. A pilot plant was under construction in January 1939. Peruvian exports of zinc concentrates declined from 29,000 metric tons in 1937 to 25,000 in 1938.

Poland.—Exports of slab zinc declined from 69,402 metric tons in 1937 to 58,123 in 1938 and imports of zinc ore from 116,000 to 104,000 tons. Mine production rose from 63,000 to 67,000 tons (recoverable content). Giesche Spolka Akcyjna increased its output of slab zinc from nearly 43,000 tons to nearly 51,000 but reported a loss of 998,027 zlotys for the year ending March 31, 1938.

Spain.—Production at the Reocin mine was reported to be approaching normal in May 1938, when the Arnao smelter was said to be producing at the rate of about 8,000 metric tons of zinc annually. French receipts of Spanish ore declined from 32,500 tons in 1937 to 1,200 in 1938, whereas German and Belgian importations increased materially.

United Kingdom.—The British Metal Corporation, Ltd., estimates consumption of zinc at 180,000 long tons in 1938, a decrease of 24,000 tons from 1937. Of the 1938 total, 63,000 tons were used for galvanizing (29,000 for sheet and 34,000 for other galvanizing), 52,000 tons

[8] Wright, Charles Will, The Lead-Zinc Deposits and Geology of the Arbus Area in Sardinia, Italy: Econ. Geol. vol. 34, No. 1, 1939, p. 82.

for brass, 29,000 tons for oxide, 20,000 tons for rolled products, 12,000 tons for die casting, and 4,000 tons for miscellaneous uses. Approximately 30 percent of the slab zinc used was supplied by domestic smelters operating largely on imported ores and 70 percent by imported metal. Imports of ore totaled 158,000 tons in 1938, of which nearly 110,000 tons came from Australia and over 45,000 tons from Newfoundland; 151,000 tons of ore were imported in 1937. Imports of slab zinc fell from 177,000 to 165,000 tons. The larger part of the metal likewise is obtained from other British countries. Shipments from Belgium declined from 57,000 to 37,000 tons. Stocks of zinc in official warehouses were 20,200 tons at the beginning and 25,400 at the close of the year. Mine production increased only slightly and amounted to approximately 6,000 tons of recoverable zinc.

Agitation for increased tariff protection for the domestic smelting industry continued during 1938. The present import duty on non-British zinc is 12s. 6d. per ton or 10 percent ad valorem, whichever is less. Early in 1939 it was proposed to raise the import duty to 30s. with a corresponding rise in the premium on Empire zinc. Of the 17s. 6d. increase in premium on Empire zinc, 10s. would be paid to Imperial Smelting Corporation as a direct subsidy and 5s. would go into a rebate pool from which zinc manufacturers would be paid draw-back on exported goods. It was reported that consumers objected to this scheme.

Yugoslavia.—Trepca Mines, Ltd., treated 655,892 metric tons of ore from its own mines in the year ended September 30, 1938, compared with 638,729 tons in the previous year. Despite the larger tonnage of ore treated the quantity of zinc concentrates produced increased only from 69,863 to 70,120 tons. In addition 101,608 tons were milled for Kopaonik Mines, Ltd., from October 1, 1937, to June 10, 1938, at which time production at the Vojetin mine of the company was discontinued because of low prices. In August 1938, the properties of the Kopaonik, Zletovo, and Novo Brdo companies were absorbed by Trepca Mines, Ltd. An agreement has been made with the Government whereby Trepca will construct an electrolytic zinc plant at Sobac with an annual capacity of 10,000 tons of metal. In the fiscal year 1938 Trepca shipped 8,000 tons of concentrates to local smelters and exported 62,000 tons, chiefly to Belgium and France.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

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

SUMMARY OUTLINE

The lead and zinc pigments industry was affected adversely by unsatisfactory conditions in the principal industries that consume pigments—manufacturers of paint, automobiles, pneumatic tires, and storage batteries. On the whole pigment consumption was at a low level in the early months of the year and improved with general industrial conditions in the third quarter. Despite declines in the final quarter most pigments were selling higher than their lowest levels of the year as 1938 ended.

Salient statistics of the lead and zinc pigments industry of the United States, 1925–29 (average) and 1934–38

	1925–29 (average)	1934	1935	1936	1937	1938
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons	154,483	78,734	96,831	118,407	98,213	98,983
Litharge do	84,845	68,733	79,930	86,246	83,902	68,711
Red lead do	41,362	26,743	28,776	34,896	33,931	30,183
Zinc oxide do	154,208	87,088	99,697	126,800	114,652	79,129
Leaded zinc oxide do	26,609	20,506	29,976	40,512	40,343	38,216
Lithopone do	177,745	145,565	159,486	158,319	154,771	125,746
Value of products:						
All lead pigments	$60,092,000	$24,002,000	$28,064,000	$34,206,000	$35,676,000	$28,204,000
All zinc pigments	41,314,000	24,106,000	26,500,000	27,862,000	28,038,000	23,301,000
Total	101,406,000	48,108,000	54,564,000	62,068,000	63,714,000	51,505,000
Value per ton received by producers:						
White lead (dry)	178	126	124	126	140	124
Litharge	176	103	104	116	143	122
Red lead	193	123	121	133	160	137
Zinc oxide	133	113	103	90	103	117
Leaded zinc oxide	124	98	93	87	104	107
Lithopone	98	84	84	82	78	79
Foreign trade:						
Lead pigments:						
Value of exports	1,346,000	404,000	512,000	546,000	586,000	510,000
Value of imports	30,000	4,000	2,000	12,000	17,000	10,000
Zinc pigments:						
Value of exports	2,150,000	395,000	392,000	420,000	610,000	339,000
Value of imports	931,000	373,000	468,000	375,000	414,000	285,000
Export balance	2,535,000	422,000	434,000	579,000	765,000	554,000

Apparently Japanese restrictions on imports of zinc metal and residues have seriously curtailed zinc oxide trade in that country. According to the Bureau of Foreign and Domestic Commerce[1] the annual production of zinc oxide in Japan was estimated at 30,000 tons, requiring about 35 percent of the total zinc imports into the country. The report also stated that most of the zinc oxide produced is consumed domestically, about 40 percent going to the paint and varnish trades and 30 percent to rubber manufacturers. A later report stated that the restrictions noted were forcing substitution of titanium pigments and lithopone for zinc oxide.

Two articles[2] published in 1938 may be of interest to the pigments industries.

Although zinc pigments fell 22 percent in total quantity compared with only 9 percent for lead pigments, they actually fared better than the latter, for they declined only 17 percent in total value compared with 21 percent. Of the principal pigments sold the average values received by producers ranged from 11 to 15 percent lower for lead pigments compared with gains in average values for zinc pigments of 1 to 14 percent. Zinc pigments made a better showing in relation to 1925–29 averages also, the total value of zinc pigments in 1938 being 56 percent of the average for 1925–29 compared with 47 percent for lead pigments. The continuing trend toward leaded grades of zinc oxide is shown in the decline of only 5 percent in pigments of this class from the high record tonnages for 1937 and 1936 compared with a decline of 31 percent from 1937 in lead-free zinc oxide. The quoted prices for lead pigments in general followed those for pig lead, receding to the low point of 1938 in midyear and rising in the third quarter. Zinc pigments were unresponsive to price changes for the metal. Prices for some were unchanged from quotations for 1937 and for others were established throughout the year at the best levels attained in 1937.

Titanium pigments again absorbed a larger share of the market for white pigments than in previous years.

PRODUCTION

In this report 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 lead and zinc pigments dropped from $63,714,000 in 1937 to $51,505,000 in 1938—only about one-half of the average annual total for 1925–29. The decline is explained by smaller total sales of all important pigments except white lead and by lower sales values of the lead pigment group. The higher average values received for zinc pigments in a small measure offset the drop in tonnage for this group.

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[1] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals and Allied Products: Vol. 12, No. 23, June 4, 1938, p. 400.

[2] Robertson, D. W., and Hoback, W. H., Survey of House Paint Primer Technology: Paint, Oil, and Chem. Rev., vol. 100, No. 3, Feb. 3, 1938, pp. 1, 16, 18, and 38.

Oil, Paint, and Drug Reporter, White Pigments in Enamel Tints: Vol. 134, No. 18, Oct. 31, 1938, p. 44.

Lead pigments.—Sales of all lead pigments except white lead in oil declined in 1938. White lead (dry) sales dropped 12 percent but the 7-percent increase in sales of white lead in oil was sufficient to explain a 1-percent increase in total white lead sales. Red lead sales were 11 percent lower and those for litharge and basic lead sulfate 18 percent and 33 percent lower, respectively. The figures for basic lead sulfate do not represent a true picture of the quantities of this pigment consumed, as they are exclusive of the amounts used in the manufacture of leaded zinc oxide. This use of basic lead sulfate has expanded sharply in recent years, and in 1938 about 7,000 tons was so consumed. Litharge made the best showing in relation to 1925–29 averages, the total for 1938 representing 81 percent of the average for 1925–29, while sales of red lead and white lead (dry and in oil) were 73 and 64 percent, respectively.

Lead pigments sold by domestic manufacturers in the United States, 1937–38

Pigment	1937			1938		
	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	7,514	$973,214	$130	5,030	$555,203	$110
Blue	1,108	147,298	133	771	88,873	115
Red lead	33,931	5,429,182	160	30,183	4,121,428	137
Orange mineral	206	49,356	240	127	27,547	217
Litharge	83,902	12,033,949	143	68,711	8,359,629	122
White lead:						
Dry	32,661	4,576,337	140	28,583	3,533,452	124
In oil [1]	65,552	12,466,396	190	70,400	11,517,656	164

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

Lead pigments sold by domestic manufacturers in the United States, 1934–38, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1934	22,569	56,165	6,399	668	26,743	234	68,733
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	28,583	70,400	5,030	771	30,183	127	68,711

Zinc pigments and salts.—Sales of leaded zinc oxide in 1938 were only 5 percent below the record tonnages for 1936 and 1937, but those for lead-free zinc oxide and lithopone fell 31 and 19 percent, respectively, from 1937. Contrary to the trend for other pigments the average values received by producers for zinc oxide and leaded zinc oxide increased in 1938 and were responsible for the smaller decline in total value for zinc pigments than that for lead pigments, despite a larger decrease in total quantity. Sales of leaded zinc oxide in 1938 were 44 percent higher than the average annual sales in 1925–29, while those for zinc oxide and lithopone were lower by 49 and 29 percent, respectively.

Large amounts of basic lead sulfate are now used in making leaded zinc oxide. Such quantities 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 declined 26 percent from the high record established in 1937.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1937–38

Pigment or salt	1937			1938		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	114,652	$11,777,131	$103	79,129	$9,253,342	$117
Leaded zinc oxide [1]	40,343	4,190,952	104	38,216	4,072,422	107
Lithopone	154,771	12,069,790	78	125,746	9,975,012	79
Zinc chloride, 50° B	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulfate	10,521	589,017	56	7,757	439,479	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, 1934–38, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1934	87,088	20,506	145,565	19,614	[1] 7,379
1935	99,697	29,976	159,486	(2)	[1] 7,892
1936	126,800	40,512	158,319	(2)	[1] 9,721
1937	114,652	40,343	154,771	(2)	10,521
1938	79,129	38,216	125,746	(2)	7,757

[1] Revised figures.
[2] Data not available.

CONSUMPTION BY INDUSTRIES

White lead.—Sales of white lead (dry and in oil) withstood unsatisfactory marketing conditions in 1938 better than other lead and zinc pigments. The total increased 1 percent compared with declines of 5 to 31 percent in the other principal pigments. About 95 percent of the white lead made is used in the manufacture of paint. The quantity consumed for this purpose in 1938 was relatively unchanged from 1937 but amounted to only 69 percent of the tonnage so used in 1929. Early in 1939 the Lead Industries Association announced a 3-year promotion campaign designed to increase the use of white lead paint. The campaign will include identification of white lead as "the most durable." Increased consumption of white lead paint would benefit the lead industry more than increases in almost any other use, for metal so used is dissipated, whereas that used in storage batteries, cable coverings, building, and for similar purposes returns to the market as scrap.

Distribution of white lead (dry and in oil) sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Paint	75,008	91,297	113,363	93,580	93,788
Ceramics	1,434	1,834	2,653	2,506	1,918
Other	2,292	3,700	2,391	2,127	3,277
	78,734	96,831	118,407	98,213	98,983

Basic lead sulfate.—The outstanding use of basic lead sulfate is in the manufacture of paint, and 87 percent of the amount reported for 1938 was sold 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 the reporting of lead tonnages. In 1938, 7,000 tons of basic lead sulfate were used in making leaded zinc oxide compared with 5,500 tons in 1937.

Distribution of basic lead sulfate sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Paints	6,611	7,770	8,124	8,255	5,024
Rubber	93	155	126	213	91
Storage batteries	139		28	6	3
Other	224	374	144	148	683
	7,067	8,299	8,422	8,622	5,801

Litharge.—Although total sales of litharge fell 18 percent in 1938 the quantity sold for use in the manufacture of storage batteries—the principal use of this pigment—was maintained at the 1937 rate. All other uses except linoleum showed more than the average drop from 1937. Less lead oxide was used in making batteries, however, for the output of black oxide or suboxide of lead by battery manufacturers declined from the peak output of 42,000 tons in 1937 to 32,000 tons in 1938. The figures on black oxide are not included in Bureau of Mines totals for litharge. Since 1931 insecticides have been the second most important use of litharge. In 1938 sales for this purpose declined 36 percent from the high record established in 1937. Information received in 1939 made it necessary to revise the figures covering distribution of sales of litharge by uses for 1934–37, as will be noted from a comparison of the following table and that on this subject on page 159 of Minerals Yearbook, 1938. Sales of litharge for use in chrome pigments for that period have been overstated, and those for varnish and paints have been understated.

Distribution of litharge sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Storage batteries	30,024	36,067	38,700	32,228	32,514
Insecticides	12,271	14,665	14,662	18,242	11,736
Oil refining	7,614	7,869	7,259	8,311	6,411
Ceramics	6,696	6,751	7,762	7,577	5,889
Chrome pigments	[1] 5,084	[1] 6,617	[1] 6,662	[1] 7,330	4,590
Varnish	[1] 1,492	[1] 1,610	[1] 4,247	[1] 3,366	2,449
Rubber	2,466	3,171	2,147	1,659	880
Linoleum	[1] 88	[1] 220	[1] 254	[1] 264	231
Other	[1] 2,998	[1] 2,960	[1] 4,553	[1] 4,925	4,011
	68,733	79,930	86,246	83,902	68,711

[1] Revised figures.

Red lead.—The principal use of red lead is in the manufacture of storage batteries, and the quantity employed for that purpose declined only 6 percent in 1938 compared with a drop of 11 percent in total red lead sales. A new process for the manufacture of this product was reported in a lecture at Birmingham, England, and is described briefly in the Oil, Paint, and Drug Reporter.[3] The process consists of direct vaporization of pure lead in an electric arc furnace and passing of the lead vapor into a precipitating chamber where it mixes with pure oxygen and, with temperature, pressure, and feeds under control, produces the new-type red lead. Higher corrosion-resisting properties and almost twice the covering qualities of standard red lead are claimed for the new commodity. A plant that will use this process was erected at Beeston, England.

Distribution of red lead sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Storage batteries	15,987	17,657	20,323	20,275	19,057
Paints	8,766	8,721	11,786	10,440	8,698
Ceramics	595	867	807	854	655
Other	1,395	1,531	1,980	2,362	1,773
	26,743	28,776	34,896	33,931	30,183

Orange mineral.—Sales of orange mineral fell 38 percent in 1938. The principal use shifted back to color pigments again after ink manufacture had ranked first for the 1 year—1937.

Distribution of orange mineral sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Ink manufacture	24	85	71	76	20
Color pigments	68	125	77	51	94
Other	142	42	100	79	13
	234	252	248	206	127

Zinc oxide.—The principal use of zinc oxide is in the manufacture of rubber, and sales for that purpose declined in the same proportion as total sales—31 percent. Sales for use in paints fell only 25 percent; but those for floor coverings and textiles, which gained against the trend in 1937, had the sharpest drop of all—66 percent. Ceramics withstood the downtrend well, declining only 6 percent. Of the production for 1938, 62 percent was made by the American process and 38 percent by the French process compared with 69 and 31 percent, respectively, in 1937. The ratio of American to French process zinc oxide in 1937 is believed to have been unduly high, owing to the tight situation regarding supplies of metal during part of that year, and the ratio in 1938 continues above that for other recent years. The proportion of French-process oxide made from scrap zinc increased again, rising from 25 percent in 1937 to 32 percent in 1938. A large amount 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

[3] Oil, Paint, and Drug Reporter, New-Process Red Lead: Vol. 133, No. 24, June 13, 1938, p. 61.

from zinc oxide totals to avoid duplication in the reporting of zinc tonnages. Zinc oxide uses in paint were discussed by Nelson.[4]

Distribution of zinc oxide sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Rubber	50,145	57,734	72,885	67,061	46,266
Paints	23,741	25,289	33,149	27,987	20,884
Ceramics	2,963	4,028	6,102	5,216	4,908
Floor coverings and textiles	4,781	7,179	7,178	9,019	3,030
Other	5,458	5,467	7,486	5,369	4,041
	87,088	99,697	126,800	114,652	79,129

Leaded zinc oxide.—The manufacture of paint uses virtually all the leaded zinc oxide made, 98 or more percent being consumed regularly for this purpose. This pigment has become increasingly popular in recent years, and sales thereof were at a record high level in 1936 and 1937. In 1938 sales declined 5 percent, a smaller decline than was indicated for any other pigment except white lead. The total for 1938 includes about 7,000 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. Leaded zinc oxide was discussed by Eide and Depew.[5]

Distribution of leaded zinc oxide sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Paints	20,376	29,632	40,156	39,584	37,348
Rubber	28	36	32	97	
Other	102	308	324	662	868
	20,506	29,976	40,512	40,343	38,216

Lithopone.—Sales of lithopone in 1938 dropped 19 percent from those in 1937. The percentage of the total used in the manufacture of paint has increased in recent years; it was 73 percent in 1929, 79 in 1937, and 81 in 1938. Lithopone statistics are given on the basis of the regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Prior to 1936 the figures were on the basis of standard-strength plus high-strength product. Data showing the increased use of high-strength lithopone are not available. Use of lithopone by the floor coverings and textiles and by the rubber industries fell considerably more in proportion than the total. On the basis of somewhat incomplete information, separation of the amounts shown in the following table for floor coverings and textiles indicates that 10,800 tons were for linoleum and felt-base floor coverings and the remainder for coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.). "Other uses" in 1938 included 1,352 tons used for paper and 477 tons for printing ink.

[4] Nelson, Harley A., Zinc Oxide Uses in Paint: Oil, Paint, and Drug Reporter, vol. 135, No. 14, Apr. 3, 1939, pp. 5, 34.

[5] Eide, A. C., and Depew, Harlan A., Leaded Zinc Oxides—Their Composition, Properties and Manufacture: Drugs, Oils and Paints, vol. 54, No. 4, April 1939, pp. 119–122, 124.

Distribution of lithopone sales, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Paints, etc	114,472	124,615	122,461	122,915	101,924
Floor coverings and textiles	14,811	19,440	23,085	20,194	15,400
Rubber	4,596	4,435	4,908	4,383	3,148
Other	11,686	10,996	7,865	7,279	5,274
	145,565	159,486	158,319	154,771	125,746

The use of ordinary-strength lithopone in the manufacture of titanated lithopone, which usually contains about 15 percent TiO_2, has increased sharply since the output of this product began. There was a drop in 1938, however, when 17,000 tons were used for this purpose compared with 19,400 tons in 1937.

Zinc sulfide.—Production of zinc sulfide was reported by four plants in 1938; but owing to the fact that one producer represents such a large part of the total, the Bureau of Mines cannot publish representative statistics. Most of the zinc sulfide is mixed with regular lithopone to make high-strength lithopone.

Zinc chloride.—The Bureau of Mines cannot report zinc chloride production because of the refusal of one of the large producers to supply reliable data.

Complete data on sales of zinc chloride are not available, but returns from producers representing two-thirds or more of the output indicate the following distribution of sales by uses in 1938:

	Percent		Percent
Soldering flux	40	Oil refining	4
Wood preserving	24	Others	7
Dry-cell batteries	14		
Vulcanized fiber	11		100

Zinc sulfate.—The trend of sales of zinc sulfate was upward from 1932 to 1937, and a new high record rate was established in 1937. In 1938 sales fell 26 percent from those in 1937. Efforts to obtain figures covering the distribution of sales of zinc sulfate were more successful in 1938 than in previous years. Of the total sales (7,757 tons), 2,851 tons were reported as sold to the rayon industry, 1,664 tons for agricultural purposes, 947 tons for chemicals, 656 tons to paint and varnish manufacturers, 285 tons for glue manufacture, 284 tons to electrogalvanizers, and 59 tons to printers and dyers of textiles; 948 tons were undistributed.

RAW MATERIALS USED IN THE 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 1938, 93 percent of the lead in lead pigments was derived from pig lead and 7 percent from ore. The proportions for zinc pigments in 1938 were 67 percent from ore, 15 percent from slab zinc, and 18 percent from secondary materials.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1937–38, by sources, in short tons

Source	1937		1938	
	Lead in pigments [1]	Zinc in pigments	Lead in pigments [1]	Zinc in pigments
Domestic ore	17,363	[2] 110,517	12,025	68,168
Metal	204,961	24,594	162,828	15,760
Secondary material [3]	127	21,526	----------	18,718
	222,451	[2] 156,637	174,853	102,646

[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, as well as 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, 1937–38, by sources, in short tons

Pigment	1937				1938			
	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	--------	90,791	--------	90,791	--------	74,128	--------	74,128
Red lead	--------	32,986	--------	32,986	--------	26,608	--------	26,608
Litharge	--------	79,704	--------	79,704	--------	60,509	--------	60,509
Orange mineral	--------	237	--------	237	--------	91	--------	91
Basic lead sulfate	5,555	977	--------	6,532	2,830	739	--------	3,569
Leaded zinc oxide	11,808	266	127	12,201	9,195	753	--------	9,948
	17,363	204,961	127	222,451	12,025	162,828	--------	174,853

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1937–38, by sources, in short tons

Pigment or salt	1937				1938			
	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	70,607	24,052	8,228	102,887	37,069	15,713	7,456	60,238
Leaded zinc oxide	20,666	542	258	21,466	18,502	--------	--------	18,502
Lithopone	[1] 19,244	--------	13,040	[1] 32,284	12,597	47	11,262	23,906
Zinc sulfide	(2)	--------	(2)	(2)	(2)	--------	(2)	(2)
Zinc chloride	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Zinc sulfate	1,105	--------	1,735	2,840	931	--------	1,395	2,326

[1] Revised figures. [2] Data not available.

PRODUCERS AND PLANTS

The following companies sold or used lead and zinc pigments and zinc salts of their own production in 1938:

White lead:	
The Eagle-Picher Lead Co	Cincinnati, Ohio.
Euston Lead Co	Scranton, Pa.
W. P. Fuller & Co	South San Francisco, Calif.
International Smelting and Refining Co. (electrolytic process).	East Chicago, Ind.
John T. Lewis & Bros. Co	Philadelphia, Pa.
National Lead Co	Melrose, Calif.
Do. (2 plants)	Chicago, Ill.
Do	St. Louis, Mo.
Do	Perth Amboy, N. J.
Do	Brooklyn, N. Y.
Do	Port Richmond, N. Y.
The Sherwin-Williams Co	Chicago, Ill.
Basic lead sulfate, or sublimed lead:	
The Eagle-Picher Mining & Smelting Co	Galena, Kans.
National Lead Co	St. Louis, Mo.
Red lead, orange mineral, and litharge:	
The Andrews Lead Co., Inc	Long Island City, N. Y.
E. I. du Pont de Nemours and Co	East Chicago, Ind.
The Eagle-Picher Lead Co	Joplin, Mo.
Do	Newark, N. J.
The Eagle-Picher Mining & Smelting Co	Galena, Kans.
W. P. Fuller & Co	South San Francisco, Calif.
Hammond Lead Products, Inc	Hammond, Ind.
Morris P. Kirk & Son	Los Angeles, Calif.
John T. Lewis & Bros. Co	Philadelphia, Pa.
Metals Refining Division of the Gidden Co	Hammond, Ind.
National Lead Co	Melrose, Calif.
Do	Chicago, Ill.
Do	St. Louis, Mo.
Do	Brooklyn, N. Y.
Do	Charleston, W. Va.
The Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc oxide and leaded zinc oxide:	
American Zinc Co. of Illinois	Hillsboro, Ill.
American Zinc Oxide Co	Columbus, Ohio.
The Eagle-Picher Lead Co	Hillsboro, Ill.
International Smelting and Refining Co. (French process).	East Chicago, Ind.
Do	Akron, Ohio.
Morris P. Kirk & Son	Los Angeles, Calif.
Monsanto Chemical Co	St. Louis, Mo.
The New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
Do. (French process)	Freemansburg, Pa.
The Ozark Smelting & Mining Division of The Sherwin-Williams Co.	Coffeyville, Kans.
Röhm & Haas Co	Bristol, Pa.
St. Joseph Lead Co. of Pennsylvania	Monaca, Pa.
Superior Zinc Corp	Bristol, Pa.
Lithopone:	
The Chemical & Pigment Co	Oakland, Calif.
Do	Collinsville, Ill.
Do	St. Helena, Md.
E. I. du Pont de Nemours and Co	Newport, Del.
Do	Newark, N. J.

Lithopone—Continued.	
The Eagle-Picher Lead Co	Argo, Ill.
Mineral Point Zinc Division of The New Jersey Zinc Co	Depue, Ill.
The New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
The Ozark Smelting & Mining Division of The Sherwin-Williams Co	Coffeyville, Kans.
The Sherwin-Williams Co	Chicago, Ill.
United Color & Pigment Co	Newark, N. J.
Zinc sulfide:	
American Zinc Oxide Co	Columbus, Ohio.
Mineral Point Zinc Division of The New Jersey Zinc Co	Depue, Ill.
The New Jersey Zinc Co. (of Pennsylvania)	Palmerton, Pa.
The Ozark Smelting & Mining Division of The Sherwin-Williams Co	Coffeyville, Kans.
Zinc salts:	
American Smelting and Refining Co	Selby, Calif.
Do	Federal, Ill.
Do	Omaha, Nebr.
Do	Perth Amboy, N. J.
Do	Pittsburgh, Pa.
Atlas Powder Co	Atlas, Mo.
The Chemical & Pigment Co	Oakland, Calif.
Charles Cooper & Co., Inc	Newark, N. J.
E. I. du Pont de Nemours and Co	East Chicago, Ind.
Do	Cleveland, Ohio.
Do	Weirton, W. Va.
General Chemical Co	Chicago, Ill.
Great Western Electro-Chemical Co	Pittsburg, Calif.
Jordan Co	Chicago, Ill.
Morris P. Kirk & Son	Los Angeles, Calif.
Mallinckrodt Chemical Works	St. Louis, Mo.
Merrimac Division of Monsanto Chemical Co.	Everett, Mass.
The Ozark Smelting & Mining Division of The Sherwin-Williams Co	Coffeyville, Kans.
Pacific Smelting Inc., Ltd	Torrance, Calif.
Röhm & Haas Co	Bridesburg, Pa.
The Ruby Chemical Co	Columbus, Ohio.
Virginia Smelting Co	West Norfolk, Va.

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 important lead pigments dropped from 11 to 15 percent, while those for zinc pigments were relatively stationary or increased up to 14 percent. The range of market quotations, as reported by the Oil, Paint, and Drug Reporter, appears in the following table. The prices for lead pigments in general followed that for pig lead, declining to the low point of the year in the middle of the year and rising in the third quarter. Quoted prices for lithopone, zinc chloride, and zinc sulfate were relatively unchanged from those for 1937, while prices for zinc oxide in general remained throughout the year at the best levels reached in 1937.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1935–38, in cents per pound

Product	1935	1936	1937	1938
Basic lead sulfate, or sublimed lead, less than carlots, barrels	6.25	6.25–6.75	6.50–8.75	5.50–6.50
White lead, or basic lead carbonate, dry, carlots, barrels	6.50	6.50–7.25	6.75–9.00	6.00–7.00
Litharge, commercial, powdered, barrels	6.00–7.00	6.00–8.50	6.25–10.00	5.50–7.50
Red lead, dry, 95 percent or less, less than carlots, barrels	7.00–8.00	7.50–9.50	7.75–11.00	7.00–8.50
Orange mineral, American, small lots, barrels:				
Ex-white lead	9.50–11.00	10.50–11.25	}10.25–13.50	9.50–11.00
Ex-red lead	9.00–10.50	10.50–11.25		
Zinc oxide:				
American process, lead-free, bags, carlots	5.00–6.50	5.00–5.25	5.25–7.50	6.25–7.50
American process, 5 to 35 percent lead, barrels, carlots	5.13–6.50	5.13–5.38	5.38–6.88	5.90–6.38
French process, red seal, bags, carlots	5.50–8.38	5.50–5.75	5.75–7.50	7.50
French process, green seal, bags, carlots	6.00–9.38	6.00–6.25	6.25–8.00	8.00
French process, white seal, barrels, carlots	6.50–10.63	6.50–6.75	7.00–8.75	8.75
Lithopone, domestic, 5-ton lots, bags	4.50	4.25–4.50	4.25–4.63	4.38–4.63
Zinc sulfide, less than carlots, bags, barrels	10.50–11.75	9.25–11.75	9.25–9.50	8.63–9.50
Zinc chloride, works:				
Solution, tanks	2.00	2.00	2.00–2.25	2.25
Fused, drums	4.50–5.75	4.25–5.75	4.25–5.75	4.25–5.75
Zinc sulfate, crystals, barrels	2.65–2.80	2.65–3.95	2.80–4.05	2.65–4.05

FOREIGN TRADE [6]

Imports of lead and zinc pigments decreased 32 percent and exports 29 percent in value in 1938. The excess value of exports over imports amounted to $554,000; it was only slightly more than one-fifth of the annual average for 1925–29. The value of imports of lead and zinc salts was less than one-half that in 1937, while the value of exports of lead arsenate, the only salt separately recorded, increased.

The following table shows the values of various pigments and salts imported and exported in 1937 and 1938.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1937–38

	1937		1938	
	Imports	Exports	Imports	Exports
Lead pigments:				
White lead	$6,677	$207,381	$3,979	$190,745
Red lead	285	158,923	79	115,348
Litharge	31	220,134	123	203,610
Orange mineral	928	(1)	271	(1)
Other lead pigments	9,406	(1)	5,533	(1)
	17,327	586,438	9,985	509,703
Zinc pigments:				
Zinc oxide	97,686	378,332	73,487	185,848
Lithopone	302,417	231,622	207,115	153,567
Zinc sulfide	13,856	(1)	4,798	(1)
	413,959	609,954	285,400	339,415
Lead and zinc salts:				
Lead arsenate	42	91,377		95,196
Other lead compounds	36,615	(1)	12,659	(1)
Zinc chloride	44,191	(1)	19,718	(1)
Zinc sulfate	29,966	(1)	16,321	(1)
	110,814	91,377	48,698	95,196
Grand total	542,100	1,287,769	344,083	944,314

[1] Data not available.

[6] 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, but imports of these compounds fell from 213 tons in 1937 to 85 in 1938. Imports of suboxide of lead fell from 28 tons in 1937 to 16 in 1938.

Lead pigments and salts imported for consumption in the United States, 1934–38, in short tons

Year	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	Total value
1934	15		(1)	5	183	[2] $29,425
1935	6	1		2	302	[2] 38,228
1936	32	2	1	5	185	[2] 37,878
1937	34	1	(1)	5	213	[2] 53,984
1938	20	1	1	2	85	[2] 22,644

[1] Less than 1 ton.
[2] Includes also—1934: Lead pigments, n. s. p. f., $18 (200 pounds), sublimed lead (basic sulfate) $39 (210 pounds); 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).

The principal exports are white lead and litharge, and these two items increased in 1938, although not significantly. Exports of red lead and lead arsenate declined in 1938. Exports of white lead, red lead, and litharge comprised less than 2 percent of domestic production of these pigments.

White lead was exported principally to the Philippine Islands, Netherlands, and Canada, while red lead and litharge were exported mainly to Canada, the Philippines, and Netherland West Indies.

Lead pigments and salts exported from the United States, 1934–38, in short tons

Year	White lead	Red lead	Litharge	Lead arsenate	Total value
1934	1,561	745	972	325	$457,273
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	604,949

White lead, red lead, and litharge exported from the United States, 1935–38, by destinations, in short tons

Destination	White lead				Red lead and litharge			
	1935	1936	1937	1938	1935	1936	1937	1938
Countries:								
Argentina	98	126	89	97	162	139	204	359
Canada	56	74	126	220	502	544	703	542
Netherlands	827	387	83	222	2	43		
Netherland West Indies	3	3	5	5	81	273	287	400
Panama	205	453	206	108	53	53	76	78
Philippine Islands	190	170	272	385	287	342	353	406
United Kingdom	93	13	23	22	2	17	20	9
Others	865	636	432	352	941	785	743	706
	2,337	1,862	1,236	1,411	2,030	2,196	2,386	2,500
Continents:								
North America	441	754	479	448	930	1,140	1,379	1,275
South America	202	218	170	221	402	344	374	494
Europe	1,242	707	232	279	139	220	157	105
Asia	285	174	336	450	335	407	413	494
Africa	166	9	18	13	224	61	63	131
Oceania	1	(1)	1	(1)	(1)	24	(1)	1

[1] Less than 1 ton.

Zinc pigments and salts.—Imports of all items shown under this heading declined in 1938. Lithopone ranks as the most important zinc pigment imported, although imports of this commodity represented only 3 percent of domestic sales in 1938. Imports of zinc oxide (dry and in oil) totaled 645 tons, a decline from 775 tons in 1937.

Zinc pigments and salts imported for consumption in the United States, 1934–38, in short tons

Year	Zinc oxide		Litho-pone	Zinc sulfide	Zinc chloride	Zinc sulfate	Total value
	Dry	In oil					
1934	1,204	64	3,927	12	382	140	$404,256
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	321,439

Exports of zinc oxide made a notable gain in 1937 but in 1938 returned to 13 percent below the 1936 level. Shipments of lithopone abroad declined sharply in 1938 and were the smallest recorded since 1933. As usual, Canada was the principal destination of exports of zinc oxide and lithopone, 514 and 1,219 tons, respectively, of the totals of 1,163 and 1,734 tons going to that country in 1938.

Zinc pigments and salts[1] *exported from the United States, 1934–38, in short tons*

Year	Zinc oxide	Litho-pone	Total value	Year	Zinc oxide	Litho-pone	Total value
1934	1,155	2,401	$395,189	1937	2,953	2,671	$609,954
1935	1,140	2,372	392,368	1938	1,163	1,734	339,415
1936	1,330	2,538	419,987				

[1] Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, 1935–38, by destinations, in short tons

Destination	Zinc oxide				Lithophone			
	1935	1936	1937	1938	1935	1936	1937	1938
Countries:								
Argentina	35	55	48	86	74	35	63	28
Canada	453	704	1,583	514	1,652	1,812	1,740	1,219
Cuba	115	80	207	48	198	186	258	115
France	15	13	111	49	2	3	1	5
United Kingdom	56	80	29	26	138	199	199	103
Others	466	398	975	440	308	303	410	264
	1,140	1,330	2,953	1,163	2,372	2,538	2,671	1,734
Continents:								
North America	724	882	1,972	659	1,969	2,104	2,184	1,483
South America	78	130	149	117	118	57	90	41
Europe	94	99	148	85	140	218	217	132
Asia	132	52	467	159	16	25	24	13
Africa	5	6	57	3	3	4	1	1
Oceania	107	161	160	140	126	130	155	64

GOLD, SILVER, COPPER, AND LEAD IN ALASKA

(MINE REPORT)

By Chas. W. Henderson

SUMMARY OUTLINE

Alaska mines yielded gold, silver, copper, and lead valued in terms of recovered metals at $26,527,315 in 1938 compared with $26,652,698 in 1937, a decrease of less than 0.5 percent. Maintaining a value of gross production in 1938 comparable with that in 1937 was due directly to a 9-percent increase in value of placer gold output; gold production from lode mines remained virtually constant through the 2 years. The value of the copper output decreased 32 percent from 1937, owing to exhaustion of the ore bodies of the two largest copper producers and to the lower average price for refined copper.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

The following tables show the mine production of gold, silver, copper, and lead in Alaska in 1934–38 and 1880–1938; the output of gold, silver, and lead from amalgamation and cyanidation mills (with or without concentration equipment) in 1938, by regions; and the output of gold and silver in 1938, by types of operation. The Bureau of Mines is not at liberty to publish separately the quantity of ore treated at straight concentration mills and that shipped crude to smelters.

Mine production of gold, silver, copper, and lead in Alaska, 1934–38, and total, 1880–1938, in terms of recovered metals

Year	Gold (lode and placer)		Silver (lode and placer)	
	Fine ounces	Value	Fine ounces	Value
1934	537, 281. 83	$18, 778, 000	168, 868	$109, 167
1935	469, 495. 00	16, 432, 325	286, 848	206, 172
1936	540, 580. 00	18, 920, 300	484, 306	375, 095
1937	627, 940. 00	21, 977, 900	494, 340	382, 372
1938	664, 973. 00	23, 274, 055	479, 853	310, 208
1880–1938	23, 023, 856. 00	518, 849, 562	18, 978, 413	13, 506, 700

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1934	114, 000	$9, 120	1, 493, 000	$55, 241	$18, 951, 528
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
1880–1938	[1] 685, 553	226, 492, 936	[1] 21, 763	2, 413, 575	761, 262, 773

[1] Short tons.

Mine production of gold and silver in Alaska in 1938, by types of operation

Type of operation	Mines producing	Material treated	Gold			Silver			Total value
			Fine ounces	Percent of total		Fine ounces	Percent of total		
				1938	1937		1938	1937	
Lode mines	70	[1] 4, 856, 719	234, 018	35	37	416, 790	87	86	$8, 460, 070
Floating connected-bucket dredges	[2] 44	[3] 19,747,660	278, 442	42	41	39, 204	8	7	9, 770, 814
Placers (dragline and dry-land dredges, hydraulic, drift mining, and sluicing)	[4] 1, 120	([5])	152, 513	23	22	23, 859	5	7	5, 353, 379
	1, 234		664, 973	100		479, 853	100		23, 584, 263
Total, 1937	1, 238		627, 940		100	494, 340		100	22, 360, 272

[1] Short tons of ore.
[2] Number of dredges. In addition, there was a floating dredge that produced platinum only.
[3] Cubic yards of gravel (average recovered per yard, $0.49).
[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 1938, 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	26, 360	29, 834. 33	1, 709	454	3, 998. 27	268	([1])	500
Kenai Peninsula	1, 718	1, 582. 00	465	12	107. 00	50	([1])	280
Kuskokwim	770	908. 80	184					
Southeastern Alaska	4, 691, 396	142, 246. 51	28, 756	3, 088	28, 352. 00	104, 181	([1])	1, 933, 894
Yukon River Basin	12, 930	10, 636. 60	2, 012	29	110. 00	423	([1])	500
	4, 733, 174	185, 208. 24	33, 126	3, 583	32, 567. 27	104, 922	([1])	1, 935, 174
Total, 1937	4, 556, 978	201, 562. 77	37, 227	3, 446	29, 771. 42	100, 140	([1])	1, 641, 441

[1] Bureau of Mines not at liberty to publish details of copper production.

Gold.—Gold contributed 88 percent of the total value of the gold, silver, copper, and lead produced in Alaska in 1938, an increase from 82 percent in 1937. Floating connected-bucket dredges, of which there were 44 in operation compared with 41 in 1937, contributed the larger part of the increase in gold output; the gold recovered was 9 percent above that in 1937. Increased use of draglines, slack-line scrapers, bulldozers, and floating washing plants in the Seward Peninsula, Yukon Basin, Kuskokwim, and Cook Inlet regions caused the gold output from other types of placer operations (excluding the floating connected-bucket type) to show the largest relative increase (10 percent) but a net increase smaller than that of the dredges. In 1938 there were 99 operators using such mechanical equipment—47 dragline and dry-land dredges, 13 slack-line drag scrapers, 15 caterpillar bulldozers, and 24 using a combination of bulldozers and hydraulic. Production from lode mines was slightly (less than 0.5 percent) lower than in 1937. Nine more lode mines were in active operation, but their added production did not suffice to offset the decline in production at the two largest lode mines in Alaska during 1938.

Silver.—The output of recoverable silver in Alaska decreased 14,487 fine ounces from 1937 to 1938. As over 50 percent of the total silver in both years was obtained as a byproduct of copper production, this decrease can be attributed directly to the decline in copper output. No mines in Alaska yielded silver as their principal product.

Copper.—The output of recoverable copper in Alaska in 1938 decreased 16 percent from 1937. This decline can be attributed directly to exhaustion of the ore bodies at Kennecott, for many years the largest copper mine in Alaska. The lowering of the average price paid for refined copper did not tend to lower the copper output from the many operations that produced copper as a byproduct of their gold production only.

Lead.—Recoverable lead production in Alaska in 1938 increased 21 percent in quantity over 1937 but decreased 6 percent in total value. The value of the lead produced was less than 1 percent of the total value of the gold, silver, copper, and lead. The bulk of the lead is recovered from lead concentrates produced by the Alaska Juneau Gold Mining Co. in the Southeastern Alaska region.

MARKETS AND METALLURGY

There are no smelters or refineries in Alaska. The bulk of the gold produced is in the form of bullion from placer and lode operations, which is sent finally to the Seattle Assay Office or the San Francisco Mint. Over half of the silver and all the copper and lead produced are obtained from high-grade ore and concentrates shipped to the Tacoma (Wash.) and Selby (Calif.) smelters.

There were 37 mines in Alaska in 1938 equipped with amalgamation or cyanidation plants—ranging in daily capacity from 1 ton to 12,000 tons—that were in continuous operation throughout the year. One mine was equipped with a flotation plant milling copper-palladium ore in the Southeastern Alaska region; one mine was equipped with a flotation- and table-concentration mill for handling copper-silver ore in the Copper River region; and 23 mines were equipped with amalgamation and cyanidation plants (chiefly amalgamation) that ran intermittently during the year. The copper concentrates shipped to

Tacoma averaged approximately 50 percent in copper content. Gold concentrates from straight concentration mills averaged over 16 ounces of gold and over 21 ounces of silver to the ton.

The gold-silver bullion is sold either direct to the Seattle Assay Office or San Francisco Mint or, first, to one of the many gold bullion buyers in the larger centers of Alaska. These purchasers of gold-silver bullion send it direct to the mint or cast it in bars for shipping; in many cases they act merely as agents for many lode and placer operators. Among the largest purchasers of gold-silver bullion during 1938 were: The First National Bank of Fairbanks, Fairbanks; the Miners and Merchants Bank of Iditarod, Flat; the Miners and Merchants Bank of Alaska, Nome; and the Northern Commercial Co. and the Seattle First National Bank, Seattle (Wash.).

The United States Assay Office, Seattle, Wash., reports the following receipts from Alaska in 1938.

Bullion of Alaskan origin deposited at United States Assay Office, Seattle, Wash. during year ended Dec. 31, 1938, in fine ounces

District	Gold	Silver
Circle	16,086.117	1,428.22
Cook Inlet	48,771.753	5,001.04
Copper River	5,758.978	1,143.74
Eagle	5,410.448	1,038.22
Iditarod	49,263.807	7,447.20
Koyukuk	1,664.992	119.37
Kuskokwim	18,063.324	1,848.46
Nome	105,918.145	11,995.85
Southeastern Alaska	141,393.724	28,598.44
Tanana [1]	211,271.634	35,038.11
	603,602.922	93,658.65

[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 14 percent of the total lode gold output in Alaska during 1938. The bulk of the metal from lodes in this region came from mines in the Willow Creek district.

The Alaska-Pacific Consolidated Mining Co. at Wasilla, operating the Independence and Martin mines, was the largest producer. The bulk of the gold from this operation was in the form of bullion shipped to the Seattle Assay Office. Some high-grade concentrates were shipped to Tacoma during the year.

Willow Creek Mines, Inc., operating the Luckyshot and War Baby mines in the Willow Creek district, was taken over by the Conwest Exploration Co. April 20, 1938, but the latter company did not begin active operations until June 20; the old name, Willow Creek Mines, Inc., was not dropped. The Conwest Exploration Co. milled 2,356 tons of gold ore during the latter part of 1938; the heads averaged 0.75 ounce of gold to the ton. The mill, of 40 tons daily capacity, concentrates crude ore by means of flotation and jigs; the flotation concentrate is cyanided and the jig concentrate is amalgamated.

The Cliff Gold Mining Co., Inc., operating the Cliff mine in the Prince William Sound district and equipped with a 30-ton amalgamation-concentration mill, handled crude ore averaging over $50 to the ton in recoverable gold. Bullion was shipped to the Seattle Assay Office through the First Bank of Valdez, and concentrates were shipped to the Tacoma smelter.

Rapp & Till, re-treating impounded tailings from the Gold Bullion mine property of Willow Creek Mines, Inc., made a creditable production.

Other operators making notable production were: The Fern Gold Leasing Co., operating in the Willow Creek district, and the Gold Cord Development Co., operating the Gold Cord mine, also in the Willow Creek district.

There were no floating connected-bucket dredges in the Cook Inlet-Susitna region in 1938. Several producers using hydraulic giants or dragline excavators and portable washing plants made a sizable production. The bulk of the gold from placer operations came from mines in the Yentna-Cache Creek district. Among the leading producers using hydraulic giants, dragline excavators, caterpillar bulldozers, and auxiliary washing plants were: Spokane Peters Creek, Inc., operating on bench gravels on Peters Creek; the Cache Creek Mining Co., operating on Cache Creek; and the Dutch Creek Mining Co., operating on Dutch Creek.

Copper River region.—The Copper River region, comprising the Chistochina, Nabesna, Nelchina, and Nizina districts, produced over half of the recoverable silver output and the bulk of the recoverable copper output of Alaska during 1938. The largest producers of copper and silver in this region were the Kennecott Copper Corporation and its subsidiary, the Mother Lode Coalition Mines Co., operating properties at Kennecott. The metal output of these mines was contained in high-grade copper ore and high-grade copper concentrates, from the 900- to 1,100-ton concentrating mill operated by the Kennecott Copper Corporation, shipped to Tacoma; no custom ores were handled. The mines of the Kennecott Copper Corporation and the Mother Lode Coalition Mines Co. were abandoned permanently during the latter part of 1938 owing to exhaustion of the ore bodies.

The Twentieth Annual Report of the Mother Lode Coalition Mines Co. for the year ended December 31, 1938 (dated April 4, 1939), says—

> In the midyear statement you were advised that operations at the mine were terminated on July 31, 1938, because of the exhaustion of the ore body. During the 7-month period of operations 16,082 tons of ore containing 2,426 tons of recoverable copper were mined. These tonnages exceed the amount estimated in the last annual report to be contained in the ore reserves on January 1, 1938, by 4,682 tons of ore containing 1,220 tons of recoverable copper.
>
> The unsold copper on hand January 1, 1938, and that mined during the 7-month period of operations, an aggregate of 7,120 tons, was sold before the close of the year.
>
> The net income of the company, after inclusion of miscellaneous other income and the deduction of all costs including taxes, but before depletion, was $508,766.75, which is equal to approximately 20 cents per share on the outstanding capital stock of the company.
>
> In the annual reports for 1936 and 1937 special reference was made to the unsatisfactory outcome of the development and prospecting work which had been carried on by the company. It had also been indicated in previous reports that the results of that work had been most unfavorable and disappointing and that no new ore bodies of commercial grade had been disclosed. Similarly, no new ore body was found during 1938. After the termination of mining operations the mine was closed down and all equipment having any net salvage value was removed from the mine and shipped out for sale. This equipment has not been sold and while the amount of salvage is not determinable at this time it will not be an important item. The 19 patented mining claims to which the company has title continue to be held.

The Twenty-fourth Annual Report of the Kennecott Copper Corporation for the year ended December 31, 1938 (dated March 21, 1939), makes the following comment on its Alaska property.

The Alaska property was operated until the latter part of October when all ore of commercial value was exhausted and the property closed down. Equipment having any net salvage value was removed and shipped out before abandonment of railroad operations. Production from this property has averaged only 525 tons copper per month since 1928 and therefore cessation of these operations will not affect earnings as this tonnage can easily be made up from other properties.

The Nabesna Mining Corporation, operating the Nabesna mine in the Nabesna mining district, produced the bulk of the output of lode gold in the Copper River region in 1938. The gold and silver recovered were contained in copper concentrates shipped to the Tacoma smelter. The Ninth Annual Report of the Nabesna Mining Corporation for the year ended December 31, 1938, says—

Comparison with last year shows that the most distinctive features of 1938 Nabesna operation have been: Increase of actual mill operating time, larger tonnage treated, better recovery, and a gross production value more than double that of any previous year's record.

The steady and the efficient working of the power plant and mill equipment with only a comparatively small amount of time needed for making repairs, general overhaul, and maintenance work made possible the increase in operating days and the larger tonnage milled.

Better recovery was made by efficient mill operation and alterations in the set-up of the flotation unit and of the reagents used. The closing down of the cyanide plant operation has also contributed to a better over-all recovery and has made possible a considerable saving in operating costs. All of these increases and improvements, together with the higher value of the ore milled, combined to give the larger gross production amount for the year.

Mining and development work were carried on continuously during the year. Work was accomplished on all levels of the mine from the 250- down to the 650-foot level. The Nugget Crosscut on the 250-foot level and the 350-foot level drift received the greater part of the development work. No new ore bodies of any importance have been found during the last few months of the year. During the year as a whole, however, mining development has shown very satisfactory results as to quantities and grade of ore developed. Especially has this been the case with the No. 49 ore body, which was found to extend for over 300 vertical feet above the 450-foot level. Ore has been mined from 53 Stope on the 550-foot level in ore that is the downward extension of the No. 45 ore body from levels above. A vein of medium-grade ore three feet wide has lately been found while extending the Nugget Crosscut farther ahead toward the main line diorite contact.

The winter production of concentrates is being stored at the mine. These will be hauled to Valdez and shipped to the smelter as soon as the road to the coast is open for traffic in the spring.

While the permanent closing of the Copper River & Northwestern railroad will shorten the season in which supplies can be freighted to Nabesna mine by about 2 months, it will otherwise cause no great inconvenience to the operation, as freight can be handled over the Valdez route at less cost than was formerly done via the railroad routing.

Historical summary of operations of Nabesna Mining Corporation, 1930–38

Year	Milled (tons)	Recovered gross value	Mill heads value per ton	Ore milled gross value	Recovery (percent)	Mill operation (days)	Underground work (linear feet)	Diamond drill work (linear feet)
1930							150	
1931	1,302	$60,759.53	$90.00	$117,180.00	50.99	60	617	
1932	2,022	131,978.54	83.68	169,200.96	81.67	86	412	
1933	2,874	141,649.68	53.54	153,873.96	81.40	119	532	
1934	9,955	244,073.69	32.86	327,121.30	74.60	170	1,868	585
1935	16,443	[1] 247,259.38	19.52	320,967.36	77.03	295	2,323	1,045
1936	11,653	[1] 190,513.11	17.99	209,637.47	90.88	223.7	3,203	1,292
1937	16,117	198,249.04	18.00	290,145.97	[2] 68.33	284.71	1,980	695
1938	18,026	525,689.98	33.65	606,629.79	86.66	312.75	2,589	1,840
Total, 1930–38	78,392	1,740,172.95	28.00	2,194,756.81	79.29	1,551.16	13,674	5,457

[1] Exclusive of bullion from stacked middlings, as follows: 1935, $10,233.57; 1936, $15,934.70. [2] Over-all.

There were no floating connected-bucket dredges in the Copper River region in 1938. The output of placer gold came from several small hydraulicking, sluicing, and drift-mining operations scattered throughout the region. The larger producers were: Green Mining Associates, hydraulicking on Boulder Creek in the Nizina district; Chititu Mines, operating on Chititu Creek in the Nizina district; Ahtell Mining Co., hydraulicking on Grubstake Creek in the Chistochina district; Rex Creek Mining Co., operating on Rex Creek near McCarthy; and John Long, operating on Copper Creek about 30 miles from McCarthy.

Kenai Peninsula region.—The Girdwood, Moose Pass, Hope, and Nuka Bay districts, included in the Kenai Peninsula region, showed a slight increase in total gold and silver output in 1938 over 1937. The bulk of the output from lode mines consisted of bullion from amalgamation-concentration mills, sent finally to the Seattle Assay Office; some high-grade dry gold concentrates were shipped to Tacoma. The large producers from lode operations in 1938 were: The Crown Point Mining Co., operating the Crown Point mine, and Ralph Reed, leasing the Alaska Oracle mine, both in the Moose Pass-Hope district; the Nuka Alaska Mining Co., operating in the Nuka Bay district; the Crow Creek Gold Corporation, operating the Monarch mine in the Girdwood district; and the Sonny Fox Mining Co., operating the Sonny Fox mine in the Nuka Bay district.

There were no dredging operations in the Kenai Peninsula region during 1938, but the combined output of the several small hydraulicking and sluicing placer operations made a production comparable with that of the lode mines.

Kodiak Island region.—The output of gold and silver from the Kodiak Island region during 1938 was confined almost entirely to operation of several small placers.

Kuskokwim region.—The bulk of the gold and silver produced in 1938 in the Kuskokwim region, which includes the Goodnews Bay, Nixon Fork, and Tuluksak-Aniak districts, was obtained from the operations of two floating connected-bucket dredges of the New York Alaska Gold Dredging Co. and one dredge of the Bristol Bay Mining Co.; the largest part of the output from dredge operations was produced, as in 1937, by the New York Alaska Gold Dredging Co., using a 2-cubic foot and a 4-cubic foot dredge.

The Bristol Bay Mining Co., using a fuel oil-powered floating connected-bucket dredge with sixty-five 2½-cubic foot buckets, operated from September 21 to October 8, 1938, and handled approximately 22,000 cubic yards of gravel. This dredge was built during the early months of the year and was put into operation during the latter part of the open season.

The Goodnews Bay Mining Co., operating its 1-year-old floating connected-bucket dredge from May 1 to November 12, recovered nearly four times as much platinum as was obtained in 1937; over a million cubic yards of gravel were washed.

The output of gold in 1938 from placer operations in the Kuskokwim region, other than that by floating connected-bucket dredges, increased greatly. Three of the larger operators, using draglines with portable washing plants and hydraulic mining methods, handled an aggregate of 327,000 cubic yards of gravel with an average recovered gold value of 64 cents to the cubic yard washed.

Among the large operators making notable production in 1938 were: Strandberg & Sons, Inc., operating on Candle Creek in the Nixon Fork district; the Kow Kow Mining Co., operating on Kow Kow Creek in the Goodnews Bay district; and Kvamme & Co., sluicing on Canyon Creek in the Bethel precinct (Tuluksak-Aniak district).

Although production from lode mines in 1938 showed an increase over 1937, it was small compared with that from all types of placer operations. Among the most important producers—all in the Nixon Fork district—were: Mespelt & Co., operating the Nixon Fork mine; E. M. Whalen, developing and producing from the Whalen mine; and McGowan & Lind, developing and operating the McGowan-Mespelt property.

Northwestern Alaska region.—The area of the Kobuk River Valley covering the Kiana and Shungnak districts comprises the Northwestern Alaska region. Mining in this region during 1938 was confined almost entirely to the operation of small placer mines, and Northwestern Alaska was not a large contributor to the total metal output of Alaska.

Seward Peninsula region.—In the Seward Peninsula region, which covers all the area of the Seward Peninsula, floating connected-bucket dredges produced 28 percent of the total gold recovered in 1938 from this type of operation in Alaska. There were 22 dredges in operation, an increase of 2 over 1937.

The average value in recovered gold from 11 of the large operators of floating connected-bucket dredges in 1938 was 43 cents to the cubic yard of gravel washed. The length of the open dredging season was 4 to 5½ months, beginning about the middle of May and lasting, in rare instances, to the first of November. Prospecting and preparation of ground for dredging were conducted throughout most of the year.

The United States Smelting, Refining & Mining Co., operating 3 electrically powered Yuba dredges (1 with 103 9-cubic-foot buckets, 1 with 89 9-cubic-foot buckets, and 1 with 78 9-cubic-foot buckets) at Nome, was the largest producer of gold in 1938 from dredge operations in the Seward Peninsula. Active dredging started May 23 and was continued for an average of 156 days per dredge during the rest of the season, each dredge averaging over a million cubic yards of gravel washed during this period. The average grade of material was slightly lower than in 1937. Addition of a fourth dredge is contemplated as soon as ample ground can be prepared for its operation.

The Arctic Circle Exploration Co., operating two dredges in the Fairhaven district during 1938, handled approximately 499,000 cubic yards of gravel averaging 69 cents in value of recovered gold to the cubic yard washed. This company, using two dredges (each equipped with 70 4-cubic-foot buckets), operated for a total of 220 dredge days. A hydraulic plant handling 104,300 cubic yards was in operation 145 days; the average grade of gravel handled was 90 cents in recovered gold value to the cubic yard.

The Bartholomae Oil Corporation and N. B. Tweet & Sons, operating dredges equipped with 31 2¾-cubic-foot buckets and 29 2-cubic-foot buckets, respectively, in the Port Clarence district washed 175,370 cubic yards of gravel in 1938 averaging 53 cents in recovered gold value to the cubic yard. The Bartholomae Oil Corporation started operations June 15 and N. B. Tweet & Sons July 15, both ending the season about the middle of October.

Other large producers using floating connected-bucket dredges in 1938 were: The Council Dredging Co., operating in the Council district; the Fox Bar Dredging Co. and the Kougarok Consolidated Placers, operating in the Kougarok district; the Alaska Sunset Mines Corporation, operating in the Nome district; and the Ungalik Syndicate, operating in the Saint Michael district.

Six operators—three in the Kougarok district, one in the Koyukuk district, one in the Nome district, and one in the Fairhaven district—using hydraulic, bulldozing, dragline, and drift mining methods, handled 97,600 cubic yards of gravel in 1938 averaging 91 cents in value of recovered gold to the cubic yard; the average period of operation was May 15 to October 12. The increased use of dragline excavators, slack-line scrapers, and caterpillar bulldozers and the use of portable washing plants have displaced to some extentthe use of hydraulic mining methods in the Seward Peninsula region.

Southeastern Alaska region.—Southeastern Alaska, comprising the Chichagof Island, Hyder, Juneau, Ketchikan, and Windham Bay districts, was the most productive lode mining region in Alaska in 1938; it yielded 74 percent of the total lode gold output. There were 17 active or developing mines in operation, but the bulk of the lode production of gold, silver, and lead came from the mining operations of the Alaska Juneau Gold Mining Co. The Twenty-fourth Annual Report of this company for the year ended December 31, 1938 (dated February 28, 1939), says—

The operating profit, before deductions for depreciation and depletion, of $2,043,059.56 for 1938 was less than that for the preceding year by $372,059.13. This reduction is the product of a small increase in operating costs, a small decrease in yield, and an increase in tons trammed. A small variation in costs and in recovery applied to the total tons for a year amounts to a substantial figure, but these small variations can neither be foreseen nor controlled.

The figures included in Superintendent Metzgar's report, attached hereto, show a gradual increase in production from the Perseverance area, and a gradual decrease in production from the South ore body. This ore body, which has been the chief source of total production for many years, will be less productive hereafter, and an increase in production from the Perseverance area will, in the future, make up for the reduced South ore body output. During the year considerable prospecting was done below the 1,000-ft. level of the North ore body and in that particular portion prospected the bottom of the ore seemed to be definitely indicated at about the 1,200-ft. level. This prospecting work, however, is not yet completed for the entire area of the North ore body.

Development work and stope preparation were continued during the year at about the same rate as in the year 1937. The total tons trammed in the year 1938 was 4,663,880, of which 1,619,570 or 34.73 percent came from the Perseverance section.

In the Perseverance section the total footage of development and preparatory work was 18,409 linear feet of development work and 11,490 square feet of stope cutout which is the equivalent of the work done the previous year; in addition, a large amount of work was done in repairing the shaft and cleaning out and restoring old levels to use. We are now well established in this section and it is a regular and important part of the mine.

The work begun last year on levels Nos. 11, 12 and 13 from the No. 53 winze was continued and ventilating raises from these levels to the levels above were driven.

A series of raises driven from level to level in the western end of the 53 area gives ventilation through to the main level above.

During the year 590,250 pounds of powder were used in blasting powder drifts, or 0.13 pound per ton trammed. The total powder consumption for mining was 0.36 pound per ton trammed as against 0.40 pound in 1937, and 0.31 pound in 1936.

Mill.—The installation of classifying cones and thickeners, mentioned in last year's report, was continued, and each section of the mill now has classifying and thickening. Additional flotation equipment was installed and now the slimes from all sections of the mill are treated by flotation. At the end of the year 2,000 tons of slimes per day were being treated. During the year 450,020 tons of slimes and 180,230 tons of reground middlings were treated in the flotation units.

Experimental work to see what further values may be recovered from the table tailings by flotation at a profit are being continued and a large capacity machine of special design has been ordered.

The fine tailings pumping plant installed in 1937 worked satisfactorily during the year. The increased tonnage handled by the mill worked the original six pumps installed to capacity so one additional pump was installed to take care of time out for repairs.

Labor.—The supply of labor was abundant throughout the year, although there was not an overabundance of skilled miners. The labor turnover was small.

Adjustments made during the last months of the year in preparation for conformance with the Wage-Hour Law resulted in an increase of the average wage per day from $6.42 in 1937 to $6.55 in 1938. The over-all cost per man per day this year was $11.22 as against $10.95 in 1937.

Power plants.—The regular volume of maintenance work on plants and transmission lines was done. In addition considerable work was done preparatory to rebuilding some of the older portions of the power transmission lines. One section of the Annex Creek line on the mountain will be moved to a location more removed from snowslides.

A power line through Sheep Creek tunnel to Perseverance shaft was completed and transformers were installed. A compressor for installation in the underground station prepared at Perseverance shaft last year has been ordered. This will take care of any additional demand for compressed air in the Perseverance section and make for flexibility of operation.

While there were no specific items of improvement this year that were as large as last the expenditures for maintenance and improvement continued large.

Gold content of ore from Alaska Juneau mine, 1934–38, and total, 1893–1938

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	
1934	2,387,138	1,915,462	0.0503	0.0034	0.0116	0.0082	0.0402
1935	2,091,475	1,638,185	.0533	.0035	.0108	.0078	.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
Total and average, 1893-1938	37,530,918	32,586,720	.0518	.0118	.0126	.0089	.0449

Gold, silver, and lead recoveries from Alaska Juneau mine, 1893–1938

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
1914–33	1,656,576.48	34,949,995.77	1,025,861.17	$565,592.01	24,248,088	$1,402,705.10	36,918,292.88
1934	128,015.26	4,465,354.31	86,458.27	53,842.93	1,662,894	63,361.73	4,582,558.97
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
Total	2,386,838.07	60,004,109.97	1,533,861.66	925,022.57	33,601,862	1,842,082.52	62,771,215.06

[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 in the Southeastern Alaska region in 1938 and shipped the bulk of the dry gold concentrates from this region to Tacoma.

The Alaska Gold & Metals Co., operating in the Ketchikan district in 1938, produced, in connection with its gold and palladium output, the bulk of the copper produced in Southeastern Alaska.

Other producers making a creditable output in 1938 were the Chichagof Mining Co., in the Chichagof Island district, and Nelson & Tift, operating in the Ketchikan 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 68 percent of the total gold output from floating connected-bucket dredges in Alaska in 1938; was the largest producer of gold and silver from other types of placer operations; and was third in total output of gold from lode mines.

The bulk of the gold produced in this region in 1938 came from the operation of 19 floating connected-bucket dredges, which washed approximately 12,750,000 cubic yards of gold-bearing gravels, averaging 52 cents in value of recovered gold to the cubic yard. The open dredging season was 4 to 8 months, although prospecting and preparation of ground for future dredging was continuous throughout the year.

The United States Smelting, Refining & Mining Co., operating six floating connected-bucket dredges—two 10-cubic-foot electrically driven dredges, with 111 and 93 buckets, respectively; three electrically driven dredges, with seventy-eight, seventy-eight, and sixty-eight 6-cubic-foot buckets, respectively; and one shallow-digging electrically powered Yuba dredge, with sixty-eight 3-cubic-foot buckets—was the largest producer of gold in this region in 1938. Dredging operations were started March 10; by March 21, five of the large dredges were in operation, continuing without interruption until early in December. The newly constructed shallow-digging dredge was operated from July to November. The six dredges aggregated 1,453 dredge days compared with 1,261 dredge days in the previous season. The yardage of gravels handled was increased substantially, but the grade was slightly lower than in 1937.

The Alluvial Gold, Inc., second-largest producer of gold in this region in 1938, operated a Diesel-powered dredge (seventy-two 4-cubic-foot buckets) on Coal Creek in the Circle district and washed 430,000 cubic yards of gravel during the period June 10 to November 1.

The North American Dredging Co., operating on Otter Creek in the Iditarod district, started operations June 15, 1938, and closed down for the season November 14. The dredge, equipped with sixty 3½-cubic-foot buckets, handled 295,000 cubic yards of gravel during the active season.

The Riley Investment Co., also operating on Otter Creek in the Iditarod district, used a Diesel-powered dredge (fifty-eight 3½-cubic-foot buckets) and handled 311,180 cubic yards of gravel in 1938. Dredging was started June 7 and continued without interruption until November 21.

Other large producers of gold from floating connected-bucket dredges in 1938 were: In the Circle district—Gold Placers, Inc., using a dredge equipped with sixty 4-cubic-foot buckets; C. J. Berry Dredging Co., using a dredge equipped with fifty-eight 3-cubic-foot buckets; and the Deadwood Mining Co., using a dredge equipped with sixty-five 4-cubic-foot buckets; in the Innoko district—the Holky Dredging Co., operating a 4-cubic-foot dredge on Ganes Creek; in the Fortymile district—North American Mines, Inc. (Jack Wade operations), dredging (seventy 4-cubic-foot buckets) on Jack Wade Creek; and in the Hot Springs district—the American Creek Operating Co., using a Yuba Diesel-powered dredge with 2½-cubic-foot buckets on American Creek.

The Yukon River Basin region produced the bulk of the gold output from placer operations in 1938, excluding that from floating connected-bucket dredges. In most of the region the water supply was ample to insure continuous operations; however, in the Fairbanks district there was a shortage of water until the middle of July when rain relieved the condition. The active working season was 110 to 130 days, beginning early in May. In most of the region, particularly the Fairbanks and Tolovana districts, more extensive use of mechanical equipment increased production of placer gold; increased production in other districts was caused by a longer-than-usual working season. The use of dragline excavators, slack-line scrapers, and caterpillar bulldozers, with auxiliary portable washing plants, was the chief method of mining employed by the large operators.

The recovered tenor of gravel handled by the larger placer operators in 1938 ranged from approximately 46 cents to approximately $1 to the cubic yard throughout the region. In the Bonnifield district two operators hydraulicked 30,000 cubic yards of gravel with an average recovered gold content of 56 cents per cubic yard washed. In the Circle district three operators, using dragline equipment, dragline scrapers, and bulldozers with elevated sluice plants, handled 310,000 cubic yards of gravel with an average recovered gold content of 59 cents. In the Fairbanks district three operators, using draglines and bulldozers with elevated washing plants, and in the Fort Gibbon district one operator, using a dragline with elevated sluices, washed an aggregate of 472,000 cubic yards of gravel with an average recovered gold content of 46 cents. In the Fortymile district the Central Development Syndicate, lessee of the Jack Wade Mining Co., hydraulicked, with the aid of two Diesel caterpillar bulldozers, 90,000 cubic yards of muck and 40,000 cubic yards of gold-bearing gravel; the average recovered gold content was 99 cents. In the Iditarod district three operators, using bulldozers, hydraulic giants, elevated washing plants, and specially constructed sluices, handled 440,000 cubic yards of gold-bearing gravel averaging 46 cents recovered per cubic yard. In the Innoko district two operators, employing dragline equipment supplemented by bulldozers and washing plants, handled 391,000 cubic yards of gravel averaging 49 cents recovered per cubic yard.

A typical operation using mechanical equipment in recovery of placer gold, of which there are many examples in the Yukon River Basin region, is that of the Cripple Creek Mining Co., operating on Cripple Creek in the Innoko district. During the open season 260,000 cubic yards of gravel were handled, with an average recovery in value of gold of 55 cents to the cubic yard. Five hydraulic giants were used in stripping the overburden from the paystreak below. A steam-driven dragline exavator was used to bring the pay gravel into the elevated sluice or washing plant. Two pumps were used to furnish adequate water for washing the gravel and to furnish water elsewhere when needed. The company used two caterpillar tractors equipped with bulldozers for general utility work, such as clearing, hauling, etc. The operation began June 20, 1938, and closed down for the season October 20.

Other operators making a notable showing in 1938 and using for the most part dragline excavators and hydraulic equipment as a prime mover of gold-bearing gravel were: The Gold King Mining Co., operating in the Bonnifield district; the Mastadon Mining Co., in the Circle district; Adolph Bock, in the Hot Springs district; the Wolf Creek Mining Co., in the Fairbanks district; and Olson & Co., Vance Hitt, and Peter Miscovich, in the Ruby district. There were more placer operations employing five men or less in the Yukon River Basin region than in any other region in Alaska.

The Yukon River Basin region was the third most productive lode mining region in Alaska during 1938. Most of the lode mines were in the Fairbanks district. The bulk of the gold and silver produced was in the form of bullion sent to local banks and buyers or to the Seattle Assay Office. Some dry gold concentrates were shipped to the Tacoma plant of the American Smelting & Refining Co. Among the larger producers of lode gold were: The Cleary Hill Mines Co., operating the Cleary Hill mine; C. M. Hawkins, operating the Sue and Spaulding mines; and the Hi Yu Mining Co., operating the Hi Yu mine, all in the Fairbanks district.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN ARIZONA

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

Copper is by far the most important mineral product of Arizona, and the rate of mining operations in the State varies directly with the average sales price of that metal. In 1937 it sold (annual average) for 12.1 cents a pound, and Arizona mines operated at the highest rate since the period 1928–30. The total value of the output of gold, silver, copper, lead, and zinc in 1937 was $90,855,462, the highest recorded since 1929. The sale price of copper started declining in the fall of 1937, and by the end of the year curtailment was in effect in nearly all the large copper-producing districts; it continued throughout 1938, and the total value of the output of the five metals dropped to $58,358,401, or 36 percent compared with 1937, owing to decreased output of copper ore combined with a lower average sales price (9.8 cents a pound) for copper.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1934–38, and total, 1860–1938, 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
1934	747	867	3, 270, 242	167, 024. 12	$5, 837, 493	4, 448, 474	$2, 875, 781
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
1860–1938	--------	--------	(1)	9, 247, 637. 00	211, 162, 450	246, 290, 559	184, 207, 570

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	178, 082, 213	$14, 246, 577	6, 877, 216	$254, 457	1, 810, 279	$77, 842	$23, 292, 150
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
1860–1938	[2] 8, 577, 198	2, 646, 180, 914	[2] 242, 379	28, 377, 844	[2] 87, 643	14, 023, 451	3, 083, 952, 229

[1] Figures not available. [2] Short tons.

Gold and silver produced at placer mines in Arizona, 1934–38, in fine ounces, in terms of recovered metals

Year	Sluicing [1]		Drift mining		Dragline dredges [2]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1934	[3] 4, 066. 45	[3] 669	(3)	(3)	2, 915. 81	369	6, 982. 26	1, 038
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

[1] Includes placer sands treated by dry concentration plants.
[2] Dragline and power-shovel excavators with sluices or special amalgamators.
[3] Figures for sluicing include those for drift mining.

Gold.—The output of recoverable gold in Arizona decreased from 332,694 fine ounces in 1937 to 305,043 ounces in 1938, or 8 percent. Gold from siliceous ores (chiefly dry and siliceous gold ore) increased 18,444 ounces in 1938 owing to marked increases in gold ore treated by cyanidation in Mohave, Pinal, and Yavapai Counties, but gold from copper ore decreased 43,509 ounces owing to general curtailment in output of copper ore in all the principal copper-producing districts of the State; the output of gold from zinc-lead ore decreased also. Gold from placers increased slightly; as usual, nearly half of it came from a dragline and floating washing plant in Yavapai County. The Copper Queen (Bisbee) branch of the Phelps Dodge Corporation was the leading gold producer in Arizona in both 1937 and 1938, and the United Verde (Jerome) and New Cornelia (Ajo) branches of the company ranked second and fourth, respectively; there were marked decreases in gold output at each of these three properties, but their total represented 39 percent of the State total. Other large gold producers in 1938 included the Goldroad property of the United States Smelting, Refining & Mining Co. in Mohave County, the Mammoth-St. Anthony Limited property in Pinal County, and the Octave unit of the American Smelting & Refining Co. in Yavapai County. Copper

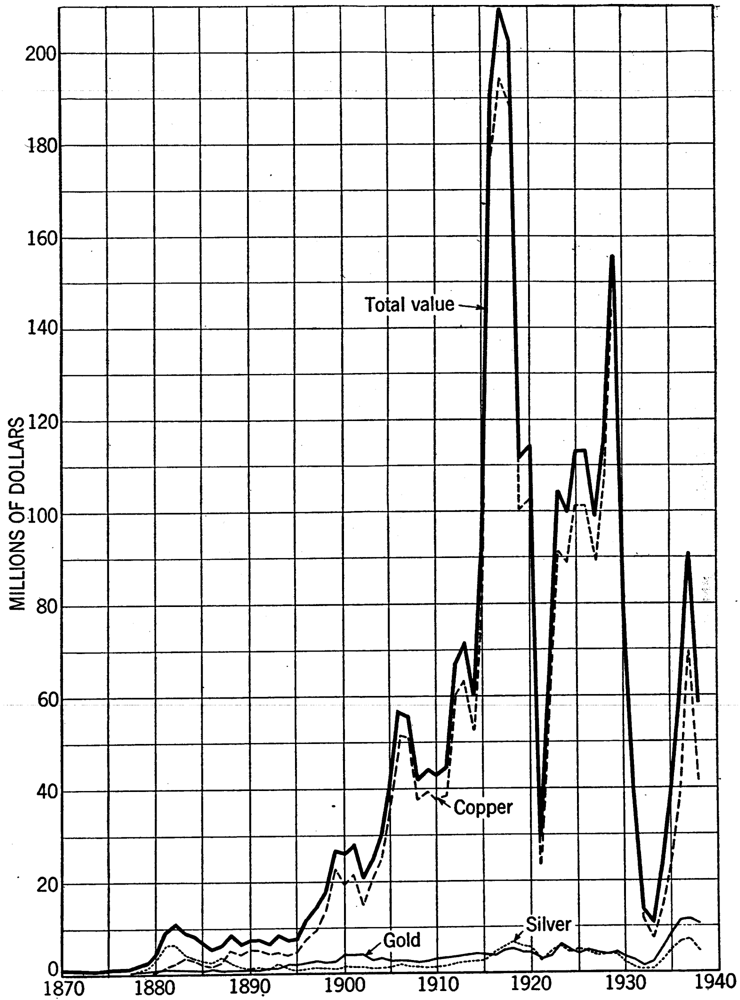

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in Arizona, 1870–1938. The value of lead and zinc has been less than $2,000,000 annually except in a few years.

ore yielded 44 percent of the total gold in 1938 compared with 53 percent in 1937, and siliceous ore yielded 49 and 40 percent, respectively.

Silver.—The output of recoverable silver in Arizona decreased 21 percent from 1937 to 1938; nearly all the decrease was in silver from copper ore, although silver from lead ore and zinc-lead ore decreased also. Copper ore yielded 61 percent of the silver in 1938 and 68 percent in 1937. The Phelps Dodge Corporation was, as usual, the chief silver producer in Arizona, and in 1938 its three properties (Copper Queen, United Verde, and New Cornelia) produced 51 percent of the State total. Other large silver producers in 1938 included the Montana group of the Eagle-Picher Mining & Smelting Co. in Santa Cruz County, the Ash Peak property of Veta Mines, Inc., in Greenlee County, and the Magma Copper Co. at Superior, Pinal County.

Copper.—The mining of copper ore is by far the most important mineral industry in Arizona. In 1937, metals recovered from copper materials were valued at $80,735,047 or 89 percent of the total value of the metal output of the State. Owing to general curtailment of output in the chief copper-producing districts, production of copper ore declined from 19,928,824 tons in 1937 to 13,047,356 tons in 1938, and the value of the metals recovered from copper materials dropped to $48,631,096, or 83 percent of the State total. The total output of copper in Arizona declined 27 percent in quantity and 41 percent in value from 1937, but, despite the marked decrease, Arizona was again the largest copper-producing State. Decreases in copper output (1938 compared with 1937) were noted in five of the seven chief copper districts of Arizona, as follows: The Globe-Miami district, 87,962,902 pounds, owing chiefly to curtailment at the Inspiration property; the Verde (Jerome) district, 26,878,875 pounds; the Ajo (New Cornelia) district, 24,390,066 pounds; the Warren (Bisbee) district, 16,946,064 pounds; and the Mineral Creek (Ray) district, 4,556,588 pounds. Copper from the Copper Mountain district increased 8,652,147 pounds owing to increased output of cement copper from underground leaching operations at the Morenci property, and copper from the Pioneer (Superior) district increased slightly (126,667 pounds). These seven districts contributed more than 98 percent of the total copper output of the State in both 1937 and 1938. Copper materials produced in Arizona in 1938 yielded 418,736,954 pounds of copper, distributed as follows: 10,118,757 tons of copper ore treated by concentration yielded 50 percent, 1,548,387 tons of copper ore shipped for smelting 35 percent, and 1,380,212 tons of copper ore leached and 18,427 tons of cement copper (from mine-water precipitates and underground leaching operations) 15 percent. In 1938 the New Cornelia property of the Phelps Dodge Corporation was again the leading copper producer in Arizona and was followed in order by the Copper Queen and United Verde units of the same company, the Miami Copper Co., the Magma Copper Co., the Inspiration Consolidated Copper Co., the Ray property of the Nevada Consolidated Copper Corporation, and the Morenci property of the Phelps Dodge Corporation.

Lead and zinc.—The output of recoverable lead in Arizona in 1938 decreased 14 percent in quantity and 33 percent in value compared with 1937. The output of zinc increased 16 percent in quantity, but it decreased 15 percent in value owing to the lower average sales price. Zinc-lead ore treated by concentration decreased from 212,430 tons in 1937 to 187,694 tons in 1938; 56 percent of the total lead and

85 percent of the total zinc in 1938 came from zinc-lead ore. Lead and zinc increased at both the Montana mine at Ruby (Santa Cruz County) and the Tennessee-Schuylkill mine near Chloride (Mohave County), but the output from the "79" mine in the Banner district (Gila County) decreased markedly. Most of the remainder of the lead produced in 1938 came from crude ore shipped for smelting, chiefly from mines in Cochise, Yavapai, and Gila Counties; nearly all the rest of the zinc came from zinc-copper ore from the Magma mine at Superior treated by flotation in a new section of the copper concentrator.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties, in terms of recovered metals

1937

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	60	4	72, 140	$2, 524, 900	3, 673, 519	$2, 841, 467
Coconino	3	-------	4	140	384	297
Gila	59	1	3, 322	116, 270	233, 925	180, 941
Graham	6	-------	6	210	2, 605	2, 015
Greenlee	11	4	1, 734	60, 690	467, 452	361, 574
Maricopa	53	27	5, 721	200, 235	32, 645	25, 251
Mohave	129	11	77, 898	2, 726, 430	640, 918	495, 750
Pima	79	16	34, 401	1, 204, 035	466, 274	360, 663
Pinal	93	1	27, 465	961, 275	879, 479	680, 277
Santa Cruz	67	1	6, 713	234, 955	735, 554	568, 951
Yavapai	261	201	102, 096	3, 573, 360	2, 285, 713	1, 767, 999
Yuma	67	110	1, 194	41, 790	4, 084	3, 159
	888	376	332, 694	11, 644, 290	9, 422, 552	7, 288, 344

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Cochise	112, 205, 000	$13, 576, 805	2, 690, 000	$158, 710	-----------	---------	$19, 101, 882
Coconino	159, 000	19, 239	-----------	---------	-----------	---------	19, 676
Gila	178, 603, 000	21, 610, 963	2, 461, 000	145, 199	1, 031, 000	$67, 015	22, 120, 388
Graham	6, 000	726	125, 000	7, 375	-----------	---------	10, 326
Greenlee	13, 659, 000	1, 652, 739	17, 000	1, 003	-----------	---------	2, 076, 006
Maricopa	332, 000	40, 172	148, 000	8, 732	-----------	---------	274, 390
Mohave	463, 000	56, 023	5, 055, 000	298, 245	3, 443, 000	223, 795	3, 800, 243
Pima	111, 279, 000	13, 464, 759	240, 000	14, 160	-----------	---------	15, 043, 617
Pinal	71, 690, 000	8, 674, 490	2, 096, 000	123, 664	-----------	---------	10, 439, 706
Santa Cruz	597, 000	72, 237	9, 798, 000	578, 082	5, 400, 000	351, 000	1, 805, 225
Yavapai	86, 805, 000	10, 503, 405	2, 042, 000	120, 478	178, 000	11, 570	15, 976, 812
Yuma	1, 158, 000	140, 118	36, 000	2, 124	-----------	---------	187, 191
	576, 956, 000	69, 811, 676	24, 708, 000	1, 457, 772	10, 052, 000	653, 380	90, 855, 462

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties, in terms of recovered metals—Continued

1938

County	Mines producing		Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Fine ounces	Value	Fine ounces	Value
Cochise	50	13	56,356	$1,972,460	2,720,172	$1,758,495
Coconino	5		3	105	263	170
Gila	64	5	2,636	92,260	73,325	47,402
Graham	11		20	700	9,620	6,219
Greenlee	8	7	1,991	69,685	532,555	344,278
Maricopa	42	23	3,657	127,995	11,569	7,479
Mohave	191	15	79,723	2,790,305	669,933	433,088
Pima	65	11	24,982	874,370	318,483	205,888
Pinal	71	2	35,877	1,255,695	877,406	567,212
Santa Cruz	57	2	6,356	222,460	610,799	394,860
Yavapai	275	170	91,473	3,201,555	1,645,824	1,063,967
Yuma	46	81	1,969	68,915	9,204	5,950
	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	95,084,959	$9,318,326	829,478	$38,156			$13,087,437
Coconino	110,551	10,834					11,109
Gila	89,418,337	8,762,997	625,000	28,750	47,000	$2,256	8,933,665
Graham	22,694	2,224	310,217	14,270			23,413
Greenlee	22,310,694	2,186,448	20,739	954			2,601,365
Maricopa	225,500	22,099	9,717	447			158,020
Mohave	330,112	32,351	4,025,152	185,157	3,319,812	159,351	3,600,252
Pima	86,959,439	8,522,025	41,218	1,896			9,604,179
Pinal	67,713,949	6,635,967	4,181,174	192,334	1,650,000	79,200	8,730,408
Santa Cruz	522,265	51,182	8,645,022	397,671	6,530,000	313,440	1,379,613
Yavapai	58,874,939	5,769,744	2,410,218	110,870	81,188	3,897	10,150,033
Yuma	20,561	2,015	44,065	2,027			78,907
	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, 1937–38, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
1937	*Short tons*	*Fine ounces*	*Fine ounces*
Cochise	1,104,738	72,058	3,673,510
Coconino	823	4	384
Gila	9,779,189	3,316	233,925
Graham	467	6	2,605
Greenlee	52,884	1,720	467,448
Maricopa	87,084	5,638	32,627
Mohave	408,808	77,779	640,883
Pima	6,094,651	34,338	466,265
Pinal	1,699,399	27,432	879,470
Santa Cruz	148,010	6,711	735,554
Yavapai	1,579,696	98,530	2,285,201
Yuma	20,610	763	4,031
	20,976,359	328,295	9,421,903
1938			
Cochise	931,572	56,276	2,720,158
Coconino	447	3	263
Gila	4,834,688	2,617	73,325
Graham	914	20	9,620
Greenlee	70,791	1,963	532,552
Maricopa	28,675	3,562	11,552
Mohave	445,253	79,637	669,916
Pima	4,994,856	24,926	318,480
Pinal	1,710,040	35,873	877,406
Santa Cruz	134,776	6,354	610,799
Yavapai	1,049,615	87,550	1,645,346
Yuma	1,537	1,277	9,108
	14,203,164	300,058	7,478,525

Gold and silver produced at placer mines in Arizona, 1937–38, by counties, in fine ounces, in terms of recovered metals

County	Sluicing [1]		Drift mining		Dragline dredges [2]		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1937								
Cochise	6				76	9	82	9
Gila	6						6	
Greenlee	14	4					14	4
Maricopa	62	13	21	5			83	18
Mohave	42	17			77	18	119	35
Pima	31	4	32	5			63	9
Pinal	33	9					33	9
Santa Cruz	2						2	
Yavapai	892	142			2,674	370	3,566	512
Yuma	187	23	205	24	39	6	431	53
	1,275	212	258	34	2,866	403	4,399	649
1938								
Cochise	31	2			49	12	80	14
Gila	19						19	
Greenlee	26	3	2				28	3
Maricopa	95	17					95	17
Mohave	86	17					86	17
Pima			56	3			56	3
Pinal	4						4	
Santa Cruz	2						2	
Yavapai	939	110			2,984	368	3,923	478
Yuma	422	64	270	32			692	96
	1,624	213	328	35	3,033	380	4,985	628

[1] Includes placer sands treated by dry concentration plants.
[2] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

There were large increases in output of copper in 1937 from mines in all seven (Ajo, Bisbee, Globe-Miami, Jerome, Morenci, Ray-Hayden, and Superior) of the principal copper-producing districts in Arizona, but curtailment during 1938 brought about large decreases in yield of copper from all of these districts except Morenci and Superior. The Phelps Dodge Corporation reduced its rate of production at Ajo, Bisbee, and Jerome, but the output of copper from underground leaching operations at Morenci increased; development and test work on the new Morenci ore body continued during both years, and plant construction was expected to begin in 1939. The Magma Copper Co. operated the mine, mill, and smelter at Superior at a normal rate during both 1937 and 1938; in 1938, in addition to copper ore, the company started treatment of zinc-copper ore in a new flotation section of the mill. The Ray property of the Nevada Consolidated Copper Corporation was closed during the summer months, and the output of copper declined. Production at both the Miami and Inspiration properties in the Globe-Miami district decreased in 1938; the Miami Copper Co. continued to treat copper ore by combined leaching and flotation throughout both years, but the Inspiration Consolidated Copper Co. discontinued the dual treatment process January 12, 1938, and straight leaching was used on the ore mined during the remainder of the year. Copper smelting plants at Douglas, Hayden, Clarkdale, Miami, Morenci, and Superior were operated continuously during 1938 but at a much lower rate than in 1937.

The average sales prices of lead and zinc declined in 1938, and the output of zinc-lead ore decreased; however, the mining of dry and siliceous ores (chiefly gold ore) continued to increase, and 928,707 tons were produced in 1938 compared with 804,949 tons in 1937.

ORE CLASSIFICATION

Details of ore classification are given in the chapter of this volume on Gold and Silver.

Ore sold or treated in Arizona, 1937–38, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc
1937		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	431	615,614	117,464	429,535	803,297	2,192,204	
Dry and siliceous gold-silver ore	29	72,888	10,861	397,595	94,397	1,419,642	18,877
Dry and siliceous silver ore	109	116,447	3,602	1,098,141	364,043	314,541	
	[1] 542	804,949	131,927	1,925,271	1,261,737	3,926,387	18,877
Copper ore	208	19,928,824	176,918	6,439,903	[2] 574,869,731	40,939	
Lead ore	145	29,969	2,346	224,839	179,831	6,914,551	
Lead-copper ore	7	59	4	773	5,216	22,897	
Zinc ore	1	91	2	90	505	1,000	34,123
Zinc-lead ore	8	212,467	17,098	831,027	638,980	13,802,226	9,999,000
Total, lode mines	[1] 888	20,976,359	328,295	9,421,903	[2] 576,956,000	24,708,000	10,052,000
Total, placers	376		4,399	649			
	1,264	20,976,359	332,694	9,422,552	[2] 576,956,000	24,708,000	10,052,000
1938							
Dry and siliceous gold ore	554	698,687	129,177	330,081	567,068	4,655,111	
Dry and siliceous gold-silver ore	73	137,062	19,011	875,415	362,559	2,433,415	81,188
Dry and siliceous silver ore	92	92,958	2,183	941,637	83,518	63,511	
	[1] 714	928,707	150,371	2,147,133	1,013,145	7,152,037	81,188
Copper ore	97	13,047,356	133,409	4,525,435	[3] 418,736,954	559	
Lead ore	96	6,072	1,048	87,700	56,776	2,031,838	
Lead-copper ore	6	201	20	2,724	9,403	31,587	
Zinc ore	1	160	33	724	1,000	2,850	41,300
Zinc-copper ore	1	32,974	372	63,845	1,189,500		1,650,000
Zinc-lead ore	7	187,694	14,805	650,964	587,222	11,923,129	9,855,512
Total, lode mines	[1] 885	14,203,164	300,058	7,478,525	[3] 421,594,000	21,142,000	11,628,000
Total, placers	329		4,985	628			
	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 95,561,691 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 and old tailings of all classes in Arizona decreased from 20,976,359 tons in 1937 to 14,203,164 tons in 1938.

Gold ore treated at amalgamation mills decreased from 46,654 tons in 1937 to 11,177 tons in 1938, but siliceous material treated at cyanidation plants increased markedly—from 385,086 to 605,367 tons. There were substantial increases in ore treated by cyanidation in Mohave, Pinal, and Yavapai Counties.

Ore and old tailings treated at concentration plants decreased from 18,203,790 tons in 1937 to 10,546,807 tons in 1938; most of the decrease was in copper ore. Ore concentrated in Arizona in 1938 comprised 30,907 tons of gold ore, 110,632 tons of gold-silver ore, 65,435 tons of silver ore, 10,118,757 tons of copper ore (compared with 17,727,531 tons in 1937), 116 tons of lead ore, 132 tons of lead-copper ore, 160 tons of zinc ore, 32,974 tons of zinc-copper ore, and 187,694 tons of zinc-lead ore. Copper ore from the Miami property and a small part of the copper ore from the Inspiration property, both near Miami, were treated by a combination of leaching and flotation, and these data are included with ore treated at straight concentration plants. Most of the ore from the Inspiration mine in 1938 was treated by straight leaching, the dual treatment having been terminated January 12, 1938.

The following tables give details of the treatment of all ores produced in Arizona in 1937 and 1938.

Mine production of metals in Arizona, 1937–38, by methods of recovery, in terms of recovered metals

Method of recovery	Material treated	Gold	Silver	Copper	Lead	Zinc
1937	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore and old tailings amalgamated	46, 654	5, 167	2, 393			
Ore and old tailings cyanided	385, 086	58, 317	90, 012			
Concentrates smelted	669, 320	110, 428	3, 064, 430	292, 507, 433	17, 694, 009	10, 039, 000
Ore smelted	2, 340, 829	154, 359	6, 264, 011	188, 886, 876	7, 013, 991	13, 000
Copper precipitates smelted	17, 010	24	1, 057	[1] 24, 683, 500		
Electrolytic copper	(2)			[2] 70, 878, 191		
Placer		4, 399	649			
		332, 694	9, 422, 552	576, 956, 000	24, 708, 000	10, 052, 000
1938						
Ore and old tailings amalgamated	11, 177	1, 796	575			
Ore and old tailings cyanided	605, 367	73, 856	134, 682			
Concentrates smelted	547, 519	106, 505	2, 817, 824	213, 197, 084	17, 889, 480	11, 628, 000
Ore smelted	1, 659, 601	117, 901	4, 525, 444	146, 657, 242	3, 252, 520	
Copper precipitates smelted	18, 427			[3] 30, 142, 472		
Electrolytic copper	[4] 1, 380, 212			31, 597, 202		
Placer		4, 985	628			
		305, 043	7, 479, 153	421, 594, 000	21, 142, 000	11, 628, 000

[1] Distributed as follows: Cochise County, 4,013,500 pounds; Greenlee County, 13,615,000 pounds; Pinal County, 6,300,000 pounds; and Yavapai County, 755,000 pounds.
[2] The copper is from 5,122,636 tons of copper ore treated by leaching and concentration at 1 plant in Gila County; the ore is included in that sent to straight concentration plants. See second table following.
[3] Distributed as follows: Cochise County, 1,500,000 pounds; Greenlee County, 22,281,450 pounds; Pinal County, 5,580,000 pounds; and Yavapai County, 781,022 pounds.
[4] Copper ore 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, 1937–38, 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
1937	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Gila	61	51	32	1	1			
Graham	150	3						
Maricopa	691	67	18	3	9	4	48	40
Mohave	41, 182	4, 294	2, 102	233	2, 278	5, 894	620	198
Pima	330	119	49	1	7	5		
Pinal	5	5	2	1	1			
Santa Cruz	50	41	26					
Yavapai	3, 793	381	110	95	364	461	3, 557	4, 243
Yuma	392	206	54	4	4			
	46, 654	5, 167	2, 393	338	2, 664	6, 364	4, 225	4, 481
1938								
Cochise	109	28	5					
Gila	135	39	10					
Maricopa	4, 683	344	111	129	166	115	355	
Mohave	3, 213	323	127	61	316	218	48	
Pima	309	96	40	11	22	22		
Pinal	70	11	16	1	2	3		
Santa Cruz	13	9	4					
Yavapai	2, 210	694	197	41	166	139	1, 107	2, 000
Yuma	435	252	65					
	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
1937								
Cochise	1, 700	11	912					
Gila	2		190					
Maricopa	21, 000	767	1, 570					
Mohave	245, 952	55, 301	81, 991					
Pima	250	31	12					
Pinal	87, 983	796	3, 930	2, 001	10, 867	20, 975		1, 575, 668
Yavapai	28, 190	1, 389	1, 403	488	7, 139	7, 912	8, 602	80, 124
Yuma	9	22	4					
	385, 086	58, 317	90, 012	2, 489	18, 006	28, 887	8, 602	1, 655, 792
1938								
Cochise	69		195					
Maricopa	11, 675	429	699					
Mohave	330, 676	63, 571	114, 028					
Pinal	165, 465	2, 169	6, 229	4, 190	19, 235	28, 536		3, 822, 391
Yavapai	97, 482	7, 687	13, 531	585	8, 076	6, 974	7, 013	39, 000
	605, 367	73, 856	134, 682	4, 775	27, 311	35, 510	7, 013	3, 861, 391
Grand total: 1937	431, 740	63, 484	92, 405	2, 827	20, 670	35, 251	12, 827	1, 660, 273
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, 1937–38, by counties, in terms of recovered metals

County	Material treated	Concentrates smelted and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
1937	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Cochise	5,771	405	175	22,226	1,546	163,055	
Gila	[1] 9,735,330	137,783	2,114	156,211	[1] 105,583,994	1,386,850	1,018,000
Greenlee	42,740	454	1,253	352,626	5,745	11,780	
Maricopa	50,125	1,013	1,400	4,605	28,810	430	
Mohave	115,109	16,857	13,842	489,853	322,918	4,854,733	3,443,000
Pima	6,091,177	183,524	33,823	442,642	111,176,260	10,571	
Pinal	1,528,806	172,190	7,976	379,416	55,182,061	295,355	
Santa Cruz	140,102	14,657	6,541	640,263	489,563	7,729,116	5,400,000
Yavapai	475,455	137,239	22,616	539,469	18,604,613	1,568,812	178,000
Yuma	19,175	2,371	18	1,868	1,099,096	13,034	
	[1] 18,203,790	666,493	89,758	3,029,179	[1] 292,494,606	16,033,736	10,039,000
1938							
Cochise	1,630	86	237	2,639	2,067	18,815	
Gila	3,443,747	62,315	1,016	49,816	57,399,448	73,500	47,000
Greenlee	64,709	721	1,518	458,426	7,718	18,500	
Maricopa	1,975	57	75	230	1,553		
Mohave	107,232	16,348	13,613	503,429	284,688	3,870,269	3,319,812
Pima	4,992,623	149,420	24,434	294,211	86,884,000	6,269	
Pinal	1,457,511	173,461	7,565	352,159	52,378,934	28,870	1,650,000
Santa Cruz	132,750	15,512	6,063	549,370	485,003	8,299,993	6,530,000
Yavapai	344,630	124,581	24,001	571,537	15,745,150	1,709,873	81,188
	10,546,807	542,501	78,522	2,781,817	213,188,561	14,026,089	11,628,000

[1] Ore yielded also 70,878,191 pounds of copper by leaching. See first table under "Metallurgic industry."

Gross metal content of concentrates produced from ore mined in Arizona, 1937–38, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1937	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	3,463	7,466	19,987	73,007	43,329	
Dry gold-silver	1,377	1,939	150,903	26,700	113,200	
Dry silver	2,942	2,041	468,890	141,654	24,111	
Copper	620,553	53,402	1,251,461	301,226,472	4,113	
Lead	30,002	44,074	1,033,747	836,939	17,809,912	2,671,504
Lead-copper	445	219	62,775	53,000	130,089	
Zinc	10,509	1,273	75,601	105,875	625,591	11,144,475
Iron (from zinc-lead ore)	29	14	1,066	93	1,626	1,304
	669,320	110,428	3,064,430	302,463,740	18,751,971	13,817,283
1938						
Dry gold	7,512	12,325	61,208	54,446	183,192	
Dry gold-silver	4,393	3,216	355,170	115,896	195,735	
Dry silver	741	1,526	465,186	8,185	27,085	
Copper	495,087	44,426	973,511	219,149,215	50,000	2,278,250
Lead	27,659	43,792	875,996	749,952	17,881,441	2,495,368
Lead-copper	22	4	492	5,113	14,590	
Zinc	12,105	1,216	86,261	221,906	521,793	12,831,329
	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, 1937–38, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1937						
Cochise	405	175	22,226	1,546	163,055	
Gila	137,784	2,115	156,211	105,583,994	1,386,850	1,018,000
Greenlee	454	1,253	352,626	5,745	11,780	
Maricopa	1,016	1,409	4,609	28,858	470	
Mohave	17,090	16,120	495,747	323,538	4,854,931	3,443,000
Pima	183,525	33,830	442,647	111,176,260	10,571	
Pinal	174,192	18,844	400,391	55,182,061	1,871,023	
Santa Cruz	14,657	6,541	640,263	489,563	7,729,116	5,400,000
Yavapai	137,822	30,119	547,842	18,616,772	1,653,179	178,000
Yuma	2,375	22	1,868	1,099,096	13,034	
	669,320	110,428	3,064,430	292,507,433	17,694,009	10,039,000
1938						
Cochise	86	237	2,639	2,067	18,815	
Gila	62,315	1,016	49,816	57,399,448	73,500	47,000
Greenlee	721	1,518	458,426	7,718	18,500	
Maricopa	186	241	345	1,908		
Mohave	16,409	13,929	503,647	284,736	3,870,269	3,319,812
Pima	149,431	24,456	294,233	86,884,000	6,269	
Pinal	177,652	26,802	380,698	52,378,934	3,851,261	1,650,000
Santa Cruz	15,512	6,063	549,370	485,003	8,299,993	6,530,000
Yavapai	125,207	32,243	578,650	15,753,270	1,750,873	81,188
	547,519	106,505	2,817,824	213,197,084	17,889,480	11,628,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
1937						
Dry gold	3,463	7,466	19,987	68,373	33,916	
Dry gold-silver	1,377	1,939	150,903	17,126	108,478	
Dry silver	2,942	2,041	468,890	135,881	16,316	
Copper	620,553	53,402	1,251,461	291,530,051	3,510	
Lead	30,002	44,074	1,033,747	644,805	16,886,050	
Lead-copper	445	219	62,775	40,000	124,000	
Zinc	10,509	1,273	75,601	71,108	520,744	10,039,000
Iron (from zinc-lead ore)	29	14	1,066	89	995	
	669,320	110,428	3,064,430	292,507,433	17,694,009	10,039,000
1938						
Dry gold	7,512	12,325	61,208	50,917	138,640	
Dry gold-silver	4,393	3,216	355,170	107,580	176,997	
Dry silver	741	1,526	465,186	7,774	19,090	
Copper	495,087	44,426	973,511	212,290,573	45,000	
Lead	27,659	43,792	875,996	582,980	17,047,080	
Lead-copper	22	4	492	4,100	13,870	
Zinc	12,105	1,216	86,261	153,160	448,803	11,628,000
	547,519	106,505	2,817,824	213,197,084	17,889,480	11,628,000

Gross metal content of Arizona crude ore shipped to smelters, 1937–38, by classes of ore

Class of ore	Ore	Gross metal content				
		Gold	Silver	Copper	Lead	Zinc
1937	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	69,376	25,269	211,452	732,810	337,839	
Dry and siliceous gold-silver	6,809	1,808	101,732	25,154	203,038	
Dry and siliceous silver	39,698	1,203	554,296	192,117	186,073	
Copper	2,201,293	123,762	5,190,900	200,742,624	62,825	
Lead	23,557	2,313	204,858	230,311	6,843,867	
Lead-copper	59	4	773	6,221	24,711	
Zinc-lead	37				10,588	15,211
	2,340,829	154,359	6,264,011	201,929,237	7,668,941	15,211
1938						
Dry and siliceous gold	60,409	22,393	136,432	531,142	777,267	
Dry and siliceous gold-silver	17,386	4,319	186,915	124,522	646,223	
Dry and siliceous silver	27,394	656	475,072	80,381	51,296	
Copper	1,548,387	89,649	3,637,677	155,760,200	730	
Lead	5,956	868	87,116	73,149	2,108,657	
Lead-copper	69	16	2,232	6,379	18,871	
	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, 1937–38, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
1937						
Cochise	1,097,267	71,872	3,650,372	108,189,954	2,526,945	----------
Coconino	823	4	384	159,000	----------	----------
Gila	43,796	1,150	77,492	2,140,815	1,074,150	13,000
Graham	317	3	2,605	6,000	125,000	----------
Greenlee	10,144	467	114,822	38,255	5,220	----------
Maricopa	15,268	3,395	26,430	303,142	147,530	----------
Mohave	6,565	2,064	61,043	139,462	200,069	----------
Pima	2,894	358	23,557	102,740	229,429	----------
Pinal	82,605	7,763	474,090	10,207,939	224,977	----------
Santa Cruz	7,858	129	95,265	107,437	2,068,884	----------
Yavapai	1,072,258	66,641	1,735,846	67,433,228	388,821	----------
Yuma	1,034	513	2,105	58,904	22,966	----------
	2,340,829	154,359	6,264,011	188,886,876	7,013,991	13,000
1938						
Cochise	929,764	56,011	2,717,319	93,582,892	810,663	----------
Coconino	447	3	263	110,551	----------	----------
Gila	10,594	1,562	23,499	421,687	551,500	----------
Graham	914	20	9,620	22,694	310,217	----------
Greenlee	6,082	445	74,126	21,526	2,239	----------
Maricopa	10,342	2,548	10,397	223,592	9,717	----------
Mohave	4,132	1,814	52,114	45,376	154,883	----------
Pima	1,924	374	24,207	75,439	34,949	----------
Pinal	86,994	6,891	490,463	9,755,015	329,913	----------
Santa Cruz	2,013	282	61,425	37,262	345,029	----------
Yavapai	605,293	46,926	1,052,968	42,340,647	659,345	----------
Yuma	1,102	1,025	9,043	20,561	44,065	----------
	1,659,601	117,901	4,525,444	146,657,242	3,252,520	----------

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
1937						
Dry and siliceous gold	69,376	25,269	211,452	703,017	221,670	----------
Dry and siliceous gold-silver	6,809	1,808	101,732	24,221	132,348	----------
Dry and siliceous silver	39,698	1,203	554,296	184,548	127,871	----------
Copper	2,201,293	123,762	5,190,900	187,792,169	40,099	----------
Lead	23,557	2,313	204,858	177,705	6,460,106	----------
Lead-copper	59	4	773	5,216	22,897	----------
Zinc-lead	37	----------	----------	----------	9,000	13,000
	2,340,829	154,359	6,264,011	188,886,876	7,013,991	13,000
1938						
Dry and siliceous gold	60,409	22,393	136,432	511,980	606,745	----------
Dry and siliceous gold-silver	17,386	4,319	186,915	114,051	579,381	----------
Dry and siliceous silver	27,394	656	475,072	75,744	44,449	----------
Copper	1,548,387	89,649	3,637,677	145,893,388	559	----------
Lead	5,956	868	87,116	56,776	2,003,669	----------
Lead-copper	69	16	2,232	5,303	17,717	----------
	1,659,601	117,901	4,525,444	146,657,242	3,252,520	----------

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
1937			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Cochise County:										
Dos Cabezas and Tevis	11	3	416	83	80	1,925	75,281	1,949		$16,418
Hartford	4		103	79		318	2,463	390		3,332
Swisshelm	5		772	100		11,682	1,149	14,085		13,506
Tombstone	16		14,551	2,237		160,958	41,132	629,932		244,939
Turquoise	10		2,583	20		6,658	98,240	6,814		18,139
Warren	6	1	1,086,259	69,535	2	3,491,735	111,982,727	2,036,305		18,804,704
Coconino County:										
Jacob Canyon	1		770	4		353	137,000			16,990
Valle	1		52			31	21,694			2,649
Gila County:										
Banner	8		44,223	285		38,318	1,563,124	2,409,813	1,018,000	437,101
Globe	28	1	9,734,324	2,878	6	190,468	177,018,025	46,322	13,000	21,671,026
Green Valley	10		182	102		97	6,711			4,457
Pioneer and El Capitan [1]	8		302	3		4,340	2,661	4,865		4,071
Roosevelt	1		51	48						1,680
Summit	3		93				12,289			1,487
Graham County: Aravaipa	3		312	3		2,605	5,289	125,000		10,135
Greenlee County:										
Ash Peak	2		52,518	1,615		465,382	8,405	11,780		418,210
Copper King Mountain and Gold Mountain	2		88	36		415	4,843	51		2,170
Copper Mountain	6		274	69		1,607	13,644,322	5,169		1,654,926
Maricopa County:										
Big Horn	4	2	96	21	12	31				1,179
Cave Creek and Camp Creek	9		3,043	1,313		1,501	2,785	678		47,493
Osborn	9		11,111	1,296		23,916	289,752	139,186		107,131
Salt River Mountains	6		1,321	632		640	3,967			23,095
San Domingo	1	17	50	7	35	14	4,595			2,037
Sunflower	2		134	117		159	504			4,279
Vulture	8	2	71,160	2,171	23	6,265	28,810	8,119		85,601
Winifred	4		98	44		22	132			1,573
Mohave County:										
Cedar Valley	3		953	133		1,320	29,413	2,170		9,363
Chemehuevis	5	3	30	48	22	48	413	1,119		2,603
Cottonwood	1		132	21		75	7,595			1,712
Gold Basin	4	7	13,373	930	20	291		1,373		33,556
Greenwood	4		50	29		9				1,022
Hacks Canyon	3		68			234	9,364			1,314

Lost Basin	--------	1	--------	--------	77	18	--------	--------	--------	2,709
Maynard and McConnico	4	--------	850	371	--------	10,786	1,810	19,508	14,646	23,650
Music Mountain	3	--------	33	37	--------	75	33	--------	--------	1,357
Owens	16	--------	1,095	209	--------	10,075	5,694	52,390	--------	18,888
San Francisco (including Gold Road, Katherine, and Oatman)	30	--------	202,904	46,514	--------	64,467	--------	--------	--------	1,677,855
Wallapai	45	--------	119,246	15,348	--------	528,640	400,182	4,978,220	3,428,354	1,511,063
Weaver	8	--------	70,054	14,139	--------	24,840	620	220	--------	514,167
Pima County:										
Ajo	3	--------	6,080,693	33,801	--------	436,004	110,750,066	--------	--------	14,921,042
Amole	8	--------	344	32	--------	892	12,347	44,271	--------	5,916
Arivaca	23	6	315	138	17	1,952	7,917	1,932	--------	8,007
Baboquivari	3	--------	143	9	--------	671	5,843	--------	--------	1,541
Cababi	7	--------	381	155	--------	177	868	--------	--------	5,667
Empire	2	--------	283	10	--------	1,541	5,099	166,509	--------	11,983
Greaterville	4	8	67	16	32	600	215	8,169	--------	2,652
Helvetia	11	--------	1,403	101	--------	14,874	43,099	--------	--------	20,255
Old Hat [2]	2	--------	10,354	24	--------	6,265	441,901	1,000	--------	59,215
Pima	6	--------	357	9	--------	2,565	7,744	17,356	--------	4,260
Quijotoa	2	--------	257	37	--------	18	33	--------	--------	1,313
Pinal County:										
Bunker Hill	5	--------	98,922	210	--------	9,651	2,791,504	--------	--------	352,587
Casa Grande	11	--------	452	87	--------	1,201	12,355	1,373	--------	5,550
Goldfields	5	--------	341	31	--------	2,512	4,868	--------	--------	3,617
Hackberry	4	--------	233	61	--------	967	2,843	--------	--------	3,227
Martinez Canyon	1	--------	4,451	11	--------	40,075	3,521	422,661	--------	56,746
Mineral Creek	7	--------	1,171,086	509	--------	23,099	34,615,149	64,780	--------	4,227,937
Mineral Hill	7	--------	1,593	20	--------	17,987	14,463	1,525	--------	16,453
Old Hat [2]	14	1	88,859	12,028	33	26,614	13,967	1,587,966	--------	538,101
Pioneer [1]	20	--------	332,368	14,102	--------	749,492	34,205,496	8,695	--------	5,212,680
Ripsey	1	--------	885	348	--------	7,404	12,719	--------	--------	19,446
Riverside	5	--------	85	11	--------	84	5,289	34	--------	1,092
Santa Cruz County:										
Harshaw	15	--------	6,696	26	--------	87,320	27,066	1,968,695	--------	187,880
Oro Blanco	11	--------	140,138	6,634	--------	641,382	488,281	7,727,966	5,400,000	1,594,331
Palmetto	3	--------	447	4	--------	62	50,595	390	--------	6,333
Patagonia	17	1	450	28	2	4,596	20,843	65,966	--------	11,019
Tyndall	10	--------	105	2	--------	874	5,157	14,322	--------	2,215
Wrightson	4	--------	139	12	--------	693	3,281	18,813	--------	2,463
Yavapai County:										
Agua Fria	4	--------	193	15	--------	128	52,529	--------	--------	6,980
Big Bug	31	25	50,315	8,587	296	116,494	256,008	210,288	--------	444,397
Black Canyon	12	7	32,160	3,234	24	77,630	22,934	273,492	--------	192,988
Black Rock	16	1	572	134	2	115	46,802	1,390	--------	10,594
Blue Tank	6	--------	157	10	--------	31	13,529	1,034	--------	2,072
Bullard	2	--------	206	69	--------	110	21,430	--------	--------	5,093

[1] Pioneer district lies in both Gila and Pinal Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
1937—Continued										
Yavapai County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Castle Creek	5	3	176	45	67	4,265	6,628			$8,021
Cherry Creek	12		614	444		843	4,066			16,684
Copper Basin	8	22	2,073	91	114	3,038	25,686	211,525	159,123	35,456
Eureka	20	1	122,138	8,463	17	150,048	1,549,041	1,192,356	18,877	671,872
Hassayampa	44	31	1,295	650	110	25,099	8,165	7,525		47,446
Humbug	8	8	372	251	71	600	884			11,841
Kirkland	7		144	128		159	686	237		4,700
Lynx Creek		38			2,590	384				90,947
Martinez	5		988	622		609	4,463			22,781
Mineral Point	4		210	153		212	1,091	492		5,680
Peck	2	1	116	1	4	7,062	480	1,100		5,760
Pine Grove	3		3,841	2,054		10,744	11,140	12,815		82,305
Silver Mountain	3	1	208	137	4	437	1,083	1,017		5,464
Squaw Peak	2		191	20		2,521	884	19,458		3,905
Tip Top	3		907	8		31,263	256	3,712		24,712
Turkey Creek	5	1	39	16	12	1,418	149	8,830		2,616
Verde	2		1,326,940	62,748		1,840,150	84,742,620			13,873,393
Walker	11		747	254		1,669	9,777	10,746		11,998
Walnut Grove	7	6	395	73	17	119	942	17		3,357
Weaver	25	51	34,134	9,846	201	10,389	15,752	85,695		366,643
White Picacho	4		501	435		128	6,818	271		16,165
Yuma County:										
Castle Dome	9		168	172		1,360	322	13,695		7,919
Cienega	5		51	16		4	6,339			1,330
Ellsworth [3]	21		591	267		225	33,099	8,440		14,022
Eureka	5		81	19		331		13,034		1,690
Fortuna	3	3	22	39	9	9				1,687
Laguna	1	10	40	6	39	14				1,586
La Paz	4	37	24	19	132	17				5,298
Muggins Mountains	1	3	20	57	37	31				3,314
Plomosa	9	45	245	116	183	137	521	424		10,659
Santa Maria	4		19,345	48		1,607	1,116,843			138,061
Other districts [4]	70	29	619	115	109	3,262	31,480	12,526		14,911
Total Arizona	888	376	20,976,359	328,295	4,399	9,422,552	576,956,000	24,708,000	10,052,000	90,855,462

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1938										
Cochise County:										
California	5		39	4		249	214	18,326		1,165
Dos Cabezas and Tevis	13	8	1,612	304	68	1,185	2,439	20,196		14,954
Swisshelm	3		265	112		10,344	357	23,239		11,711
Tombstone	8		9,329	1,877		104,346	31,980	629,435		165,239
Turquoise	15		1,141	87		9,572	12,469	110,782		15,551
Warren	5	2	919,185	53,892	3	2,594,377	95,036,663	27,500		12,878,356
Coconino County:										
Jacob Canyon	2		243	3		130	51,816			5,267
Ryan	2		59			51	10,082			1,021
Valle	1		145			82	48,653			4,821
Gila County:										
Banner	12	2	8,951	918	8	8,565	340,816	604,304	47,000	101,401
Globe	30	2	4,824,508	1,170	10	57,666	89,055,123	20,305		8,806,915
Green Valley	12	1	537	284	1	379	1,755			10,392
Pioneer [1]	5		197	13		6,268	2,663	391		4,786
Roosevelt	1		375	228		215	184			8,137
Summit	3		119	3		232	17,796			1,999
Graham County: Aravaipa	9		878	12		9,405	22,694	310,217		22,994
Greenlee County:										
Ash Peak	2		70,270	1,795		530,012	9,388	18,500		407,230
Copper King Mountain	2		219	74		594	4,837	196		3,457
Copper Mountain	4		302	94		1,946	22,296,469	2,043		2,189,696
Maricopa County:										
Big Horn	6	3	1,175	79	18	99	867			3,544
Cave Creek and Camp Creek	11		5,281	1,293		2,011	114,643			57,790
Ellsworth [3]	3		47	39		17	316			1,407
Estrella Mountains	1		44	29		17	225			1,048
Osborn	3		3,519	487		7,722	103,847	9,717		32,661
Salt River Mountains	3		1,320	561		481	2,898			20,230
San Domingo		11			61	14				2,144
Vulture	5	2	15,540	873	4	1,086	1,908			31,584
Winifred	5		1,719	180		113	653			6,437
Mohave County:										
Cedar Valley	4		2,652	321		1,270	765	9,565		12,571
Chemehuevis	9	6	299	134	29	133	1,031	1,065		5,941
Gold Basin	13	7	8,078	918	46	294		1,283		33,989
Greenwood	7		70	34		14				1,199
Lost Basin	2	2	69	63	11	14				2,599
Maynard and McConnico	7		1,144	570		1,338		1,044		20,863
Minnesota	3		4,096	1,388		1,601				49,615
Music Mountain	7		244	145		908				5,662
Owens	21		754	377		2,560	17,153	4,500		16,738
San Francisco (including Gold Road, Katherine, and Oatman)	47		240,421	47,432		78,326		456		1,710,776
Wallapai	59		109,810	15,027		560,518	311,163	4,007,239	3,319,812	1,262,478
Weaver	11		77,614	13,226		22,954				477,749

[1] Pioneer district lies in both Gila and Pinal Counties.
[3] Ellsworth district lies in both Maricopa and Yuma Counties.
[4] Includes districts having a production valued at less than $1,000.

Mine production of gold, silver, copper, lead, and zinc in Arizona, 1937–38, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
1938—Continued			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Pima County:										
Ajo	1		4,979,870	24,399		285,997	86,360,000			$9,502,132
Amole	3		72	6		543	3,469	7,000		1,223
Arivaca	21	6	219	104	19	1,980	1,143	3,435		5,855
Baboquivari	4	2	414	153	5	2,642	694	239		7,317
Cababi	6		351	127		1,912	4,194	15,065		6,785
Empire	2		25			1,301	969	4,435		1,140
Greaterville	3	3	14		32	34		1,935		1,231
Helvetia	7		819	38		9,637	18,184			9,342
Old Hat [2]	1		12,858	49		8,616	564,786			62,634
Pima	10		76	1		908	2,347	8,826		1,258
Roskruge	1		62	1		4,288	2,204			3,023
Pinal County:										
Bunker Hill	4		79,610	457		16,765	3,252,469	13,870		346,213
Casa Grande	14		830	317		3,383	2,786	12,565		14,133
Cottonwood	2		119	59		51	112			2,109
Hackberry	3		59	20		263	3,786			1,241
Mineral Creek	4		1,098,290	446		23,299	30,058,561	314,022		2,990,856
Mineral Hill	6		349	15		5,380	3,694			4,365
Old Hat [2]	11	2	165,870	21,686	4	35,439	25,684	3,837,391		961,097
Pioneer [1]	16		362,060	12,146		774,661	34,332,163		1,650,000	4,369,653
Ripsey	3		2,581	681		17,868	27,500			38,081
Riverside	4		235	36		249	7,143			2,121
Santa Cruz County:										
Harshaw	12		1,367	25		52,255	16,316	298,304		49,977
Oro Blanco	19		133,044	6,258		552,174	485,316	8,300,413	6,530,000	1,318,811
Patagonia	7	2	264	52	2	1,830	7,796	31,022		5,264
Redrock	3		28	1		1,932	11,102	2,413		2,483
Tyndall	8		24	3		1,553	1,490	7,674		1,608
Yavapai County:										
Agua Fria	1		72	3		48	15,000			1,606
Big Bug	14	23	32,326	7,418	1,047	104,838	112,633	670,217		405,917
Black Canyon	11	7	25,927	2,763	33	91,117	10,755	334,935		173,225
Black Rock	14	1	172	272	3	246	4,571	19,370		11,123
Castle Creek	3	5	68	41	29	3,304	286			4,614
Cherry Creek	19		725	425		775	5,888			15,953
Copper Basin	5	11	200	124	91	110	214	4,391		7,819
Eureka	24	1	75,149	8,711	3	184,652	768,551	1,303,826	81,188	563,552
Hassayampa	60	20	2,522	1,216	103	14,768	16,653	11,522		57,874
Humbug	5	11	212	204	36	1,007	439			9,094

Kirkland	3	4	36	20	12	17	480			1,178
Lynx Creek		22			2,108	311				73,981
Martinez	7		58,044	3,673		10,395	7,051			135,966
Mineral Point	6		338	142		382				5,217
Peck	8	1	395	26	3	26,529	1,296	1,196		18,347
Pine Grove	8		3,681	1,934		19,472	27,265	2,174		83,050
Silver Mountain	3	1	64	30	1	164	153	5,087		1,440
Tiger	5		99	45		17				1,586
Tip Top	4		795	5		22,227	122	1,609		14,630
Turkey Creek	7	3	59	50	11	608	92	152		2,544
Verde	3		799,564	45,541		1,144,652	57,863,745			8,004,559
Walker	19	2	915	262	6	4,588	19,429	391		14,268
Walnut Grove	10	12	1,692	171	45	345	704	2,044		7,946
Weaver	22	37	45,537	14,115	363	13,232	10,020	41,239		518,163
White Picacho	7		723	308		1,915	9,592	12,065		13,513
Yuma County:										
Castle Dome	4		367	619		5,346	439	39,152		26,965
Dome		11			54	14				1,899
Ellsworth [3]	19		506	303		461	14,306	3,326		12,458
Laguna		10			42	3				1,472
La Paz and Trigo	3	22	7	85	191	45				9,689
La Posa	2		71	25		116	3,796			1,322
Plomosa and La Cholla	6	28	318	201	376	3,199	500	1,587		22,385
Other districts [4]	47	36	800	200	107	2,182	4,245	8,805		12,977
Total Arizona	885	329	14,203,164	300,058	4,985	7,479,153	421,594,000	21,142,000	11,628,000	58,358,401

[1] Pioneer district lies in both Gila and Pinal Counties.
[2] Old Hat district lies in both Pima and Pinal Counties.
[3] Ellsworth district lies in both Maricopa and Yuma Counties.
[4] Includes districts having a production valued at less than $1,000.

In the following review by counties and mining districts only the more important operations are mentioned. Many producing mines and several districts whose output was small, included in the foregoing tables, are omitted from this review.

COCHISE COUNTY

Dos Cabezas and Tevis district.—In 1937 the metal output of the Dos Cabezas and Tevis district was chiefly copper ore from the Tout property, gold ore from the Good Luck and Golden Eagle mines, and placer gold from Inspiration Placers; Inspiration Placers, Inc., operated a dragline dredge and treated 3,116 cubic yards of gravel. In 1938 the plant handled 14,775 cubic yards. The increase in district gold production resulted from resumption of operations at the Dives property by Consolidated Gold Mines, Ltd., which installed a new 200-ton rod mill and treated about 1,500 tons of gold ore.

Swisshelm district (Webb, Elfrida).—Nearly all the output of the Swisshelm district in both 1937 and 1938 was gold-silver ore from the Alpine property operated by the Alpine Mining Co.

Tombstone district.—The value of the metal output of the Tombstone district in 1938 was $79,700 less than in 1937, owing chiefly to decline in output of gold-silver ore from the Tombstone (Bunker Hill) property, chief producer in the district. There was also a decrease in output of lead ore from the Tombstone Extension and Toughnut mines. The United States Smelting, Refining & Mining Co. suspended operations at the Toughnut mine in June 1937.

Turquoise district (Courtland, Pearce, Gleeson).—In 1937 the output of the Turquoise district was mostly silver ore from the Commonwealth mine treated by cyanidation, and copper ore from the Black Diamond and Casey mines. In 1938 the output of copper decreased as both mines were closed, but the output of gold, silver, and lead increased, owing to shipments of silver ore from the Mona mine, lead ore and gold-silver ore from the Silver Bill claim, and lead ore from the Dragoon, Elsicore, Garnet, American, and Arizona properties. The Commonwealth mine was virtually idle in 1938.

Warren district (Bisbee, Lowell, Warren).—The value of the metal output of the Warren district decreased from $18,804,704 in 1937 to $12,878,356 in 1938, chiefly as a result of curtailment in output of copper ore from the Copper Queen branch of the Phelps Dodge Corporation. There was also a large decrease in output of copper ore from the Denn and Holbrook mines and of gold ore and lead ore from the Shattuck mine. The Phelps Dodge Corporation operated its Copper Queen branch throughout both years, but the output of copper ore was 9 percent less in 1938 than in 1937. The Copper Queen branch was the largest producer of gold and silver in Arizona in both years and ranked second in copper. The Denn mine was operated throughout both years by the Shattuck Denn Mining Corporation; 105,697 tons of copper ore were shipped to a smelter in 1937 and 72,030 tons in 1938. Lessees operated the Shattuck mine in 1937 and shipped 7,423 tons of lead ore, 5,610 tons of gold ore, and 3,388 tons of copper ore; the property was idle in 1938. The output of copper-gold ore from the McKenna Lease at the Holbrook property (Phelps Dodge Corporation) declined from 42,600 to 5,784 tons.

COCONINO COUNTY

The metal output of Coconino County in both 1937 and 1938 was copper ore, chiefly from claims near Jacob Lake owned by the Los Angeles Exploration & Metals Corporation and operated by lessees. Other producers of copper ore in 1938 were the Pack Rat claim near Valle and the Brown Derby and Little Buck mines in the Ryan (Warm Springs) district.

GILA COUNTY

Banner district.—The output of all metals except gold in the Banner district decreased considerably in 1938 from 1937 owing to the closing in March 1938 of the Christmas copper property and to the sharp decline in output of lead ore and zinc-lead ore from the "79" mine. The Christmas mine, idle since May 1932, was reopened early in 1937 by the Christmas Copper Corporation, and 30,170 tons of copper ore were shipped to a smelter; the output dropped to 6,098 tons in 1938. In 1937 the "79" Lead-Copper Co. was a large producer of lead and zinc, in consequence of the construction of a 60-ton flotation plant; the plant was completed in May, and during the remainder of the year 10,483 tons of zinc-lead ore were treated by concentration, and 3,435 tons of first-class lead ore were shipped to a smelter. In January 1938 the mine and mill were closed, owing to the decline in metal prices. The mine was reopened by lessees who shipped 19 cars of first-class lead ore to a smelter. The increase in district gold production in 1938 resulted chiefly from shipments of gold ore from the Gold Queen, Arizona Apex, and Inseparable mines and lead ore containing gold from the Arizona Apex and Oro Verde properties.

Globe-Miami district.—The value of the metal output of the Globe-Miami district decreased from $21,671,026 in 1937 to $8,806,915 in 1938 owing to curtailment in output of copper ore from the Inspiration and Miami properties. In 1937 the Inspiration Consolidated Copper Co. treated 5,122,636 tons of copper ore by leaching and concentration, but in 1938 the output dropped to 1,484,614 tons; most of the ore in 1938 was treated by straight leaching. The output of copper ore from the Miami mine, treated by leaching and concentration, declined from 4,602,205 to 3,338,845 tons. According to the company printed annual report for the year ended December 31, 1938, a small amount of molybdenite (valued at $32,000) was recovered (beginning in August) from copper sulfide concentrates. In 1937 most of the gold production of the district came from the Miami, Inspiration, Abbie, Golden Eagle, Old Dominion, and Porphyry Reserve properties; in 1938 most of it came from the Miami property.

Green Valley district (Payson).—The increase in production of gold in the Green Valley district in 1938 resulted chiefly from operation of the Gowan (Verde Falls) property; lessees shipped several cars of gold ore to a smelter. Other producers of gold ore in 1938 included the Tornado, Gray Eagle, and Gold Hill claims.

Pioneer district.—Nearly all the output of the Pioneer district in 1938 was silver ore from the Pioneer and El Capitan properties and gold-silver ore from the Marland (Stigall) and Little Four mines. The chief production in 1937 was silver ore from the El Capitan and Silver Dime properties.

Roosevelt district.—The output of the Roosevelt district in both 1937 and 1938 was rich gold ore from the Christmas Gift & Good Luck property; the output increased considerably in 1938.

GRAHAM COUNTY

Metal production in Graham County was greater in 1938 than in 1937 owing to increased shipments of lead-silver ore from mines near Klondyke in the Aravaipa district. In 1938 nearly all the output of the county was first-class lead-silver ore from the Grand Reef, Dogwater, Alaman, Aravaipa, and Shim Fein properties in the Aravaipa district; in 1937 most of the output came from the Shim Fein claim.

GREENLEE COUNTY

The Ash Peak (Duncan) and Copper Mountain (Morenci) were the chief producing districts in Greenlee County in both 1937 and 1938. The Ash Peak mine, virtually the only producer in the Ash Peak district, was operated by Veta Mines, Inc. The company became a large producer of silver and gold in 1937, and the output of each metal increased in 1938. About 64,700 tons of silver ore were treated in the company flotation plant in 1938, and 5,560 tons of similar ore were shipped to a smelter. The output of the Copper Mountain district in both years was mostly copper recovered from leaching old caved stopes at the Morenci branch of the Phelps Dodge Corporation; the production of copper was much larger in 1938 than in 1937, and experimental work and development on the new Morenci ore body continued during 1938. The remainder of the county output in 1938 was chiefly gold ore and gold-silver ore from the Keating and Buzzard Shadow properties in the Copper Mountain district and gold ore from the Gray Mare and Polaris mines in the Copper King Mountain district.

MARICOPA COUNTY

The value of the metal output of Maricopa County was $116,370 less in 1938 than in 1937, owing chiefly to decline in production of gold from the Vulture and Belmont-McNeil tailing dumps and from the Portmanteau mine. In 1937 more than 80 percent of the gold production of the county came from these three properties. In 1938 most of the production came from the Blue Bird, Portmanteau, and Maricopa mines in the Cave Creek district, the Vulture mine and tailings dump in the Vulture district, the Delta mine in the Salt River Mountains district, and the Belmont-McNeil mine and tailings dump in the Osborn district. Nearly all the ore output of the Cave Creek, Salt River Mountains, and Osborn districts was first-class gold ore shipped to smelters; gold ore from the Vulture mine was treated by amalgamation and concentration, and most of the old Vulture tailings were treated by cyanidation.

MOHAVE COUNTY

Cedar Valley district.—The output of ore in the Cedar Valley district was much less in 1938 than in 1937, but production of gold was larger owing to increase in output of gold ore from the San Francisco mine. A new 40-ton flotation plant was constructed at the mine in 1938, and about 2,600 tons of ore were concentrated. Several thousand tons of tungsten ore from the Boriana mine were concentrated in 1937, but no ore was treated in 1938 as the mill was destroyed by fire; however, a new 150-ton concentration plant was built during the year.

Chemehuevis district.—The chief production in the Chemehuevis district in 1938 was gold ore from the Gold Dome and Dinero mines and placer gold from the Chief claim.

Gold Basin district.—The value ($33,989) of the metal output of the Gold Basin district in 1938 was virtually the same as that in 1937. In 1937 nearly all the output was gold ore treated by cyanidation, chiefly from the Cyclopic property. In 1938, production of gold from this property decreased considerably, but the loss was more than offset by increases at the O. K. & Excelsior, Gold Hill, Golden Rule, Narrow Gauge (Fry), and M. O. mines.

Maynard and McConnico district.—The Bimetal (McGuire) property at McConnico was the most important producer in the Maynard and McConnico district in both 1937 and 1938; several hundred tons of gold ore were treated each year by cyanidation. The Dean mine 14 miles east of Kingman was a producer of zinc-lead-silver ore in 1937 but was idle in 1938. Gold-silver ore from the Democrat mine and gold ore from the Southern Cross and Fay properties were treated in 1938 in the Vivian custom mill.

Minnesota district.—The Pope mine 40 miles north of Chloride became a large producer of gold ore in 1938; the property was operated by the Arizona-California Exploration Co., and 4,073 tons of ore were treated in the custom cyanide mill of Producers Mines, Inc.

Music Mountain district.—Nearly all the output of the Music Mountain district in 1938 was gold ore from the Roosevelt, Music Mountain, and Wierth properties, treated by concentration and cyanidation in the Vivian custom mill.

Owens (McCracken and Potts Mountain) district.—In 1937 most of the output in the Owens district was silver-lead ore from the Silver Streak and McCracken mines; gold ore from the Yucca, Greenwood, Mahogany, Kimball, and Golden Eagle properties; and gold-copper ore from the New England mine. In 1938 the chief production was gold ore from the Yucca, Gold Leaf, New England, Gold Chief, and Adela properties; silver ore from the Silver Streak mine; and gold ore and copper ore from the New England mine.

San Francisco (Oatman, Gold Road, Katherine, Vivian) district.—Production of gold in the San Francisco district in 1938 was 47,432 fine ounces, an increase of 918 ounces over 1937; production of silver also increased, and the value of the total metal output rose from $1,677,855 to $1,710,776. The largest increase was in output of gold ore from the Goldroad mine of the United States Smelting, Refining & Mining Co. In both years the property was the leading gold producer in Mohave County and the largest producer of gold from siliceous ore in Arizona. The company operated its 300-ton cyanide plant throughout 1938 and treated 125,572 tons of gold ore and 15,769 tons of old tailings.

The output of gold ore and old tailings from 32 properties at Oatman and Gold Road was 203,706 tons in 1938, which yielded 42,457 ounces of gold and 32,438 ounces of silver, compared with 179,585 tons in 1937, which yielded 42,196 ounces of gold and 36,940 ounces of silver. The Tom Reed Gold Mines Co. operated its mine and 300-ton cyanide plant at Oatman continuously in 1938, but the output of gold ore dropped to 25,171 tons from 47,364 tons in 1937, resulting in a substantial decline in production of gold; the mill treated both company and custom ore. In 1938 the Big Jim mine of the United Eastern

Mines Co. and the Gray Eagle mine of the Tom Reed Gold Mines Co. were operated as a joint lease by Johnston & Witcher Mines, Inc., and the Tom Reed Gold Mines Co.; 13,700 tons of gold ore were treated in the Tom Reed mill. Lessees continued to operate the Pioneer group in 1937 and 1938; 2,622 tons of gold ore were treated in the Tom Reed mill and 6,111 tons in the Vivian mill in 1938. Lessees also continued to operate the United Western mine, and 4,014 tons of gold ore were treated in the Tom Reed mill in 1938; the property was taken over late in the year by the Vivian Mining Co., and 838 additional tons of ore were treated in the Vivian mill. The Vivian Mining Co. constructed a new 100-ton flotation plant in April 1937 and later added cyanide leaching tanks to treat the gold concentrates; 14,941 tons of gold ore from the Vivian-Lelande group were treated during 1937. In February 1938 the company started buying custom ore, and by the end of the year the mill had treated 18,350 tons of ore, including 13,650 tons from custom shippers. Other large producers of gold ore at Oatman were the Gold Dust, Mossback, Telluride, and Oatman Queen.

The output of gold ore and gold-silver ore from 15 properties in the Katherine section of the San Francisco district was 36,715 tons in 1938, which yielded 4,975 ounces of gold and 45,888 ounces of silver, compared with 23,319 tons in 1937, which yielded 4,318 ounces of gold and 27,527 ounces of silver. Three properties—the Katherine, Arabian, and Philadelphia—operated by the Gold Standard Mines Corporation produced 33,930 tons of ore in 1938; the Katherine was by far the largest producer. The Gold Standard Mines Corporation operated its 300-ton cyanide plant continuously in 1937 and 1938 on both company and custom ore. In 1938 the mill treated 23,529 tons of gold ore from the Katherine mine, 7,659 tons of gold-silver ore from the Arabian mine, and 2,742 tons of gold ore from the Philadelphia mine. In 1938 other large producers of gold ore were the Frisco and Tyro mines. In 1937 the chief producers were the Tyro, Arabian, Philadelphia, Katherine, Frisco, and Pyramid properties.

Wallapai district (Cerbat, Chloride, Mineral Park, Stockton Hill).—The value of the metal output of the Wallapai district in 1938 was $1,262,478, a decrease of $248,585 from 1937. The output of ore and all the metals, except silver, was less than in 1937; the decline in production of lead was most pronounced. The Tennessee mine of the Tennessee-Schuylkill Corporation at Chloride was the most important producer in the district in both years, ranking second in the State as a zinc producer, second in lead, and seventh in gold. About 54,000 tons of zinc-lead ore from the mine were treated in the company flotation plant in 1938, a decrease from 59,990 tons in 1937; the mill also treated custom ore. The Diana property of the Arizona Magma Mining Co. at Chloride was an important producer of gold-silver ore in both 1937 and 1938; the company treated 25,086 tons of ore by flotation concentration in 1938, an increase of 5,219 tons over 1937. Keystone, Inc., was a large producer of silver ore and gold-silver ore in 1937 through operation of several properties at Mineral Park. In April 1938 the company sold its holdings, including a 100-ton flotation plant, to Alpha-Keystone Mines, Inc. The mill was used in 1938 to treat gold-silver ore from company mines and from custom shippers; most (about 17,500 tons) of the ore came from company mines—the Keystone, Summit, Alpha, Jemison, Blue Bell, and Miner's Hope.

The Fountain Head mine was a large producer of gold ore of smelting grade in both 1937 and 1938. Other large producers in 1938 of gold ore were the Rainbow, Golden Eagle, Oro Plata, Idaho, and Lillian mines and of gold-silver ore the C. O. D., Minnesota-Connor, Juno, White Eagle, Golconda, and Good Hope properties. Silver ore from the Alpha, Prince George, Midnight, American Nettie, and Oro Plata properties and lead ore from the Golden Eagle, Fountain Head, White Eagle, St. Louis, and Samoa mines were shipped for smelting; zinc ore from the Idaho mine and zinc-lead ore from the Champion, Columbus, Tintic, and Mary Bell properties were concentrated. In 1937 the General Ore Reduction Co. built a 50-ton flotation plant at Chloride to treat custom ore. The company treated several thousand tons of ore from various mine dumps in the district during the last quarter of 1937 and the first quarter of 1938; operations were suspended in April.

Weaver (Mocking Bird, Pilgrim, Portland) district.—The value of the metal output of the Weaver district in 1938 was $477,749, a decrease of $36,418 from 1937. The output of both gold and silver was less than in 1937 owing to the large decline in output of gold ore from the Portland mine, the most important producer in the district in both years; 25,419 tons of gold ore were treated in the cyanide mill at Katherine compared with 44,325 tons in 1937. The Pilgrim mine, a large producer of gold ore in 1936, was operated from January 1 to May 31, 1937, by the Pioneer Gold Mining Co.; on June 1 the property and 100-ton flotation mill were purchased by Producers Mines, Inc. The mill operated throughout the year and treated a total of 18,750 tons of gold ore by concentration; nearly all the concentrates were amalgamated. In January 1938 the company completed conversion of the mill into a 300-ton cyanide plant, and it was used during the remainder of the year to treat both company and custom ore; 10,571 tons of gold ore and 20,236 tons of old tailings from the Pilgrim property were treated. Producers Mines, Inc., also purchased the Klondyke and Scout groups in 1937; these properties were large producers of gold ore in both 1937 and 1938. More than 14,000 tons of gold ore from the Klondyke mine and 3,250 tons of similar ore from the Scout property were treated in 1938 by cyanidation. The Mocking Bird mine was also a large producer of gold ore in both years. Other leading producers of gold ore in 1938 were the Dixie Gold and Dixie Queen properties.

PIMA COUNTY

The output of gold, silver, and copper in Pima County declined markedly from 1937 to 1938, owing to curtailment in production of copper ore at the New Cornelia mine at Ajo, most important producer in the county. The output of copper ore from this mine declined 18 percent, and that of copper more than 24,000,000 pounds; however, the mine maintained its rank as the largest producer of copper in Arizona. About 4,980,000 tons of copper ore were treated in 1938 in the flotation plant. Considerable copper was produced in both 1937 and 1938 from the Old Hat (Santa Catalina Mountains) district as a result of operations by the Catalina Consolidated Copper Co. at the Geesaman & Daily groups. The company, organized early in 1937, built a new 100-ton flotation plant and from August to the end of the year treated 10,300 tons of copper ore; production continued until June 1938, when operations were suspended. The remainder of the county output in 1938 was mostly gold ore from the Allison mine in the Baboquivari district, the Jaeger property in the Cababi district, and various claims in the Arivaca district; and silver ore from the Blue Jay mine in the Helvetia district. The Blue Jay mine produced considerable silver ore in 1937 also. Most of the lead produced in the county in 1937 came from the State of Maine group in the Empire district; the property was idle in 1938.

PINAL COUNTY

Bunker Hill district (Copper Creek).—The output of gold, silver, and copper in the Bunker Hill district was greater in 1938 than in 1937. Nearly all the output in both years was copper-molybdenum ore and old tailings from the Childs property, operated by the Arizona Molybdenum Corporation. In 1938 about 44,200 tons of ore and 35,000 tons of old tailings were treated by flotation concentration and 143 tons of high-grade copper ore were shipped for smelting.

Casa Grande district.—The value of the metal output of the Casa Grande district in 1938 was more than double that in 1937, owing to increase in shipments of gold ore from the Desert Queen, Turning Point, Greenback, Mammon, and Christmas Gift properties.

Martinez Canyon district.—The large output of silver and lead in the Martinez Canyon district in 1937 resulted from operations at the Silver Bell mine by the Sunbeam Gold Mining Co., the only producer. The company built a 50-ton flotation plant and treated about 3,000 tons of lead-silver ore; in addition, it shipped several hundred tons of first-class lead-silver ore and silver ore to a smelter. The property was idle in 1938.

Mineral Creek district (Ray).—The Nevada Consolidated Copper Corporation resumed operations at the Ray property in January 1937, and during the year treated 1,166,441 tons of copper ore in the 12,000-ton flotation plant; in addition, it shipped 3,678 tons of crude copper ore, 3,690 tons of copper precipitates, and 766 tons of old tailings for smelting. In 1938 the mine and mill were idle from June 16 to August 15, and the output of copper ore declined to 1,097,532 tons. As a result, the output of copper and gold from the Mineral Creek district decreased. There was, however, a large increase in the district output of lead in 1938 owing to shipments of lead ore from the Ray Silver-Lead property.

Mineral Hill district.—The chief production in the Mineral Hill district in both 1937 and 1938 was silver ore from the Rainbow Silver mine near Superior. The output of ore from the mine was much less in 1938 than in 1937.

Old Hat district (Oracle, Mammoth).—The value of the metal (gold, silver, copper, and lead) output of the Old Hat district in Pinal County was $961,097 in 1938, an increase of $422,996 over 1937. This substantial gain resulted from increase in output of ore from the Mammoth-St. Anthony property operated by Mammoth-St. Anthony, Ltd. The company treated 128,876 tons of ore in 1938 by gravity and flotation concentration and cyanide leaching. Lead concentrates (3,257 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. About 36,600 tons of similar ore from the New Year-Mohawk group were treated in the Mammoth-St. Anthony mill during 1938; the property, operated by the Molybdenum Gold Mining Co., was a large producer in 1937 also. The Catalina mine was a fairly large producer of gold ore in 1937 but was idle in 1938. The remainder of the district output in 1938 was mostly gold ore from the Old Gold Camp, Smith, North Star, and Bishop properties.

Pioneer district (Superior).—The value ($4,369,653) of the metal output of the Pioneer district in 1938 was greater than that of any other district in Pinal County, owing chiefly to the large output of gold, silver, copper, and zinc from the Magma mine, of gold from the Lake Superior & Arizona group, and of silver from the Reymert mine. The mine, mills, and smelter of the Magma Copper Co. were operated nearly all of 1938. The copper mill treated 246,690 tons of copper ore containing 0.027 ounce of gold and 1.18 ounces of silver to the ton and 5.12 percent copper; the new zinc unit treated 32,974 tons of zinc-copper ore containing 0.015 ounce of gold and 2.514 ounces of silver to the ton, 2.08 percent copper, and 8.41 percent zinc; and 54,975 tons of crude copper ore from the mine were smelted. In 1937, the output of the mine was 302,360 tons of copper ore; no zinc-copper ore was treated. The output of gold ore of smelting grade from the Lake Superior & Arizona group was 9,068 tons in 1938, a decrease of 1,645 tons from 1937; the ore contained 3,017 ounces of gold, 7,206 ounces of silver, and 101,229 pounds of copper. The Reymert mine was operated in both years by lessees; about 16,000 tons of silver ore were shipped in 1938 for smelting, an increase of 2,900 tons over 1937. The Belmont mine also was a large producer of silver ore during both years.

Ripsey district.—Production of gold, silver, and copper in the Ripsey district was much greater in 1938 than in 1937, owing to increased output of gold-silver ore from the Old Ripsey mine and to shipments of gold-silver ore from the Joe Fishback property. The Old Ripsey mine was the only producer in the district in 1937 and the most important producer in 1938.

Riverside district.—Nearly all the output of the Riverside district in 1938 was gold ore from the Arizona Gold and Lucky Strike mines and copper ore from the Peg Leg claim.

SANTA CRUZ COUNTY

Harshaw district.—The value of the metal output of the Harshaw district was $137,903 less in 1938 than in 1937 owing to substantial reduction in output of lead-silver ore from several producers. The largest decrease (4,765 tons) was reported from the Trench mine. In 1937 the property was operated by the Gold Canyon Mining Co. and was the largest producer of silver and lead in the district. The American Smelting & Refining Co. purchased the mine in December 1937 and operated it throughout 1938, but the output of ore was small and came entirely from development, as no stoping was done. The Hardshell, World's Fair, Flux, Humboldt, and Salvador mines also were fairly large producers of lead and silver during both years.

Oro Blanco district (Ruby).—The Oro Blanco district is the chief producing area in Santa Cruz County, as the Montana mine of the Eagle-Picher Mining & Smelting Co. is in the district; this mine is the outstanding producer of lead and zinc in the State, ranks third in output of silver, and also produces much gold and copper. The output of zinc-lead ore from the mine and the yield of gold, silver, and copper were less in 1938 than in 1937, but production of lead and zinc was much greater; 132,450 dry tons of ore were treated in 1938 in the company 300-ton flotation plant. The remainder of the district output was mostly gold ore from the Old Glory & Sargent, Margarita, and Azteca properties and gold-silver ore from the Old Soldier claim.

Palmetto district.—Several cars of copper ore from the Three R property were shipped to a smelter in 1937, but the property was idle in 1938.

Patagonia (Washington, Duquesne) district.—In 1937 the output of the Patagonia district was mostly lead-silver ore from the Mowry. Pocahontas, and Empire properties and copper ore from the Paymaster claim. In 1938 the chief production was gold ore from the Guajolote mine and lead ore from the Duquesne property.

YAVAPAI COUNTY

Agua Fria district.—The chief output in the Agua Fria district in both 1937 and 1938 was copper ore from the Burzog (Minor) property.

Big Bug district.—The value of the metal output of the Big Bug district decreased from $444,397 in 1937 to $405,917 in 1938 owing to the closing in October 1937 of the Gladstone-McCabe property, which made a large output of gold ore from 1934 to 1937, inclusive. The Iron King mine was the most important producer in the district in both 1937 and 1938. The property was operated by Burnham & Fields from January 1 to May 10, 1937, when it was purchased by the Iron King Mining Co.; a total of 22,602 tons of first-class gold ore was shipped for smelting in 1937. The company built a 200-ton flotation plant in 1938, which was placed in operation in September; 13,477 tons of gold ore were milled, and 17,078 tons of crude ore were shipped for smelting. The Belcher mine was a large producer of gold ore in 1937, and the old Blue Bell and Hackberry properties yielded a fairly large output of copper ore; the Belcher and Blue Bell properties were both idle in 1938, and the Hackberry mine was closed in February 1938. The output of placer gold in the district increased to 1,047 ounces in 1938 owing to operation of a dragline dredge at the Lawson group by the Hassayampa River Mining Co. and to operation of a washing plant, equipped with four Ainlay bowls, at Hill Placers.

Black Canyon district.—The value of the metal output of the Black Canyon district was $173,225 in 1938 compared with $192,988 in 1937; the output of gold and copper declined, but that of silver and lead increased. Two fairly important producers of gold in 1937—the Golden Belt and French Lily mines—were idle in 1938. The Golden Turkey Mining Co. was the chief producer in the district in both years. The company operated its mine and 50-ton flotation plant continuously, and the output of ore (25,765 tons) and production of gold (2,550 ounces) in 1938 were virtually the same as in 1937, but production of silver and lead was greater. The remainder of the district output in 1938 was chiefly rich silver ore from the Silver Cord and Thunderbolt mines.

Black Rock district.—In 1937 the output of the Black Rock district was mostly copper ore from the Amazon and Paydirt properties. In 1938 the chief production was rich gold ore from the Gold Bar mine.

Castle Creek district.—Most of the lode output of the Castle Creek district in both 1937 and 1938 was silver ore from the Little Joker claim and gold ore from the Golden Aster mine. Placer gold was recovered largely from the Buckhorn property in 1937.

Cherry Creek district.—Metal production in the Cherry Creek district in 1938 was virtually the same as in 1937; nearly all the output in both years was gold ore of smelting grade. The chief producers in 1938 were the Logan, Sunnybrook, Cross Cut, Gold Bullion, Gold Eagle, D. D., Gold Ring, Fox No. 1, Red Pig, and Volcano properties.

Copper Basin district.—There was a substantial increase in the metal output of the Copper Basin district in 1937 over 1936 owing to operation of the U. S. group, idle for many years. This property was taken over early in 1937 by U. S. Mines, Inc.; about 1,600 tons of zinc-lead ore were hauled to the Yarnell flotation plant, and 244 tons of first-class lead ore were shipped to a smelter. However, the property was closed late in 1937 and was idle in 1938. Most of the remainder of the district lode output in 1937 was copper-gold ore from the Plymouth mine and zinc ore from the Boston-Arizona property. The chief production in 1938 was gold ore of smelting grade from the Gold Star and McNary properties and placer gold from the Smith & Roby claim.

Eureka district.—The value of the metal output of the Eureka district was $563,552 in 1938, a decrease of $108,320 from 1937. Production of gold, silver, lead, and zinc from the Hillside mine, most important producer in the district, was greater than in 1937, but there was a substantial decrease in output of copper ore from the Bagdad property as it was closed in April 1938. The Hillside mine and 200-ton flotation plant were operated continuously in 1938 by Hillside Mines, Inc., and 38,850 tons of gold-silver ore containing copper, lead, and zinc were concentrated; the property was a large producer of gold, silver, and lead. About 75,500 tons of copper ore from the Bagdad mine were treated by concentration in 1937, but the output dropped to 29,200 tons in 1938. Most of the remainder of the district output in 1937 was gold ore from the Oro Bueno, Turnbeaugh, and Belle-Mammoth properties. Comstock-Dexter Mines, Inc., built a 100-ton flotation plant at its property in 1938 and treated 4,220 tons of gold ore. The Santa Maria Mining Corporation was organized early in 1938 to operate several mines near Hillside, including the Turnbeaugh, Pocahontas, and Anarchist groups. The company purchased the 25-ton cyanide plant of the Oro Bueno Mining Co. and moved it to the Turnbeaugh property; during 1938 about 1,500 tons of gold ore were treated in the plant, and 340 tons were shipped for smelting. Other producers of gold ore in 1938 included the Mammoth-Belle, Mystery, Southern Cross, and Juan Olea properties.

Hassayampa (Groom Creek, Hassayampa River, Senator, Prescott) district.—The output of gold in the Hassayampa district increased from 760 fine ounces in 1937 to 1,319 ounces in 1938; however, the value of the metal output of the district has decreased considerably since the closing in September 1936 of properties operated by Bradshaw Mines, Inc. In 1937 the chief output was gold ore from the Climax, Alma, Great Divide, Pine Grove, Sacramento, and Storm Cloud properties and silver ore from the Cornucopia mine. In 1938 most of the production was gold ore from the Gold Basis, Great Divide, Sterling, Pine Grove, Climax, Sacramento, Ten Spot, Forest & Forlorn Hope, Alma, The Mary, and Hot Roll properties. Small-scale operations at various prospects in the district in both 1937 and 1938 resulted in shipments of small lots of rich gold ore.

Humbug district.—Rich gold ore from the Little Joseph, Humbug Gold Mines, and Acquisition properties was shipped in 1938 for smelting; the Little Joseph and Acquisition mines were producers in 1937 also. The placer output of the district in both years was recovered by various operators working on Cow, French, and Humbug Creeks.

Lynx Creek district.—Production in the Lynx Creek district in both 1937 and 1938 was placer gold and silver; it was recovered chiefly from property operated by the Lynx Creek Placer Mine Co. The company continued to be the largest producer of placer gold in the State, although its output was 18 percent less in 1938 than in 1937. The large floating washing plant and two draglines were operated continuously from January 1 to October 30, 1938, and treated 556,115 cubic yards of gravel.

Martinez (*Congress*) *district.*—The value of the metal output of the Martinez district increased from $22,781 in 1937 to $135,966 in 1938 owing to treatment of old Congress tailings and to shipments of low-grade gold ore from Congress waste dumps. The Congress Mining Corporation rebuilt the 300-ton cyanide plant at the Congress mine and from May to the end of 1938 treated 51,625 tons of old tailings; in addition, lessees shipped 5,536 tons of low-grade ore from the waste dumps for smelting. The rest of the district output in 1938 was mostly gold ore of smelting grade from the Coronado (Golden Wave), Blue Bird, and Key properties. Nearly all the output in 1937 was first-class gold ore from the Blue Bird and Coronado mines.

Mineral Point district.—In 1938 the output of the Mineral Point district was chiefly gold ore of smelting grade from the Buster and Lucky Joe claims. In 1937 the chief producers were the Emmett & Golden Eagle, Gold Dyke, and Gringo claims.

Peck district.—The Swastika mine near Cleator was the most important producer in the Peck district in both 1937 and 1938; several cars of rich silver ore were shipped each year for smelting.

Pine Grove district.—The value ($83,050) of the metal output of the Pine Grove district in 1938 was virtually the same as in 1937. The Gladiator-War Eagle property became a large producer of first-class gold ore of smelting grade in 1937, and shipments continued throughout 1938. Other producers of gold ore in 1938 were the Harrington, Oro Belle, and Del Pasco properties.

Silver Mountain district (*Wagoner*).—Gold ore from the Silver Dollar mine was the chief output of the Silver Mountain district in both 1937 and 1938. The property was operated by Colossal Mines, Inc., until May 5, 1938, when operations ceased.

Tip Top district.—Nearly all the output of the Tip Top district in both 1937 and 1938 was silver ore from the "76" mine; several hundred tons of ore were concentrated, and exceptionally rich silver ore was shipped to a smelter. The property was operated both years by the La Bajada Exploration, Engineering & Equipment Corporation.

Verde district (*Jerome*).—The value of the metal output of the Verde district was $8,004,559 in 1938 compared with $13,873,393 in 1937. The loss resulted from curtailment in output of copper ore from the United Verde mine. The property (both the open-pit and underground sections of the mine) was operated continuously in 1938 by the Phelps Dodge Corporation; 557,762 tons of ore were smelted and 230,187 tons of ore were concentrated, but the output of copper ore declined 39 percent from 1937. The property ranked second in the State in production of gold and silver and third in copper. The 1,600-ton flotation plant and the 5,000-ton copper smelter owned by the company were operated throughout the year. However, the company dismantled one reverberatory furnace at the smelter and four Great Falls type converter stands and installed two new Pierce-Smith type converters. The United Verde Extension Mining Co. worked its mine until April 30, 1938, when operations were closed permanently and the company was dissolved. During the first 4 months of the year 7,762 tons of copper ore were shipped to the Phelps Dodge smelter at Clarkdale. The remainder of the district output in 1938 was gold-silver ore (3,853 tons) shipped from the Iron King-Equator group by A. B. Peach.

Walker district.—In 1937 most of the output of the Walker district was gold ore from the Golden Fleece, Farnum, and Cherry Grove claims. In 1938 the chief production was gold ore and gold-silver ore from the Sheldon mine.

Walnut Grove district.—Production of gold from both lode and placer mines in the Walnut Grove district in 1938 increased over 1937. The increase from lode properties resulted from operations at the Gold Bug-Gold Spring group by the Gallup Gold Mining Co. The company constructed a 100-ton cyanide plant in 1938, and 1,500 tons of gold ore were treated during the year. In 1937 Gold King Mines, Inc., operated the property and treated gold ore in a concentration mill. Various placer operators working on Placeritas Gulch and French Creek recovered more gold than in 1937.

Weaver district (*Octave*).—Production of gold in the Weaver district increased from 10,047 fine ounces in 1937 to 14,478 ounces in 1938, owing chiefly to the large output of gold ore from the Alvarado mine. However, the Octave mine remained the most important producer in the district, and its output of gold in 1938 was greater than in 1937. The mine and the flotation and cyanidation plant were operated continuously by the American Smelting & Refining Co.; 27,480 tons of gold ore were treated in 1938. Liberty Hill Gold Mines, Ltd., completed construction of a 75-ton cyanide plant at the Alvarado mine in June 1938, and during the last 6 months of the year the plant treated 14,808 tons of gold ore. The Johnson mine, a large producer of gold ore in 1937, was closed April 5, 1938, after treating 960 tons of gold ore by amalgamation and concentration. The Yarnell property also was a large producer of gold ore in 1937, but the mine and 50-ton flotation mill were idle most of 1938; about 1,300 tons of gold ore were concentrated during the last quarter of 1938. Other producers of gold ore in 1938 included the Dora, York, Cuba, and Rincon properties. The output of placer gold in the district increased from 201 fine ounces in 1937 to 363 ounces in 1938; the chief producer in 1938 was the Universal Placer Mining Corporation operating a 1¼-yard power shovel and a dry concentration plant at the Thunder Bird property.

White Picacho district.—In 1937 nearly all the output of the White Picacho district was gold ore of smelting grade from the Young property 12 miles northeast of Morristown; in 1938 this mine was also the most important producer in the district. The Independence mine produced 65 tons of lead-silver ore in 1938.

YUMA COUNTY

The value of the metal output of Yuma County was $78,907 in 1938, or $108,284 less than in 1937. This sharp decline resulted from the closing in September 1937 of the Swansea copper mine in the Santa Maria (Planet) district. The mine and 250-ton flotation mill were operated 8 months in 1937 by the American Smelting & Refining Co., 19,111 tons of copper ore were concentrated, and the property was by far the most important producer in the county; the mine was idle in 1938. More than a third of the gold produced in the county in both 1937 and 1938 was recovered by various placer operators, chiefly in the Plomosa, La Paz, Dome, and Laguna districts. The output of gold from lode mines in the county increased considerably in 1938, owing to increased shipments of rich gold ore (containing appreciable silver) from the Big Eye mine in the Castle Dome district. Most of the output in the Ellsworth district in 1938 was gold ore of smelting grade from the Golden Star, Desert, Gold Leaf, Blue Eagle, and Centroid properties and copper-gold ore from the Critic mine. Exceptionally rich gold ore was produced in 1938 from the Ah-Ve-Aha claim in the La Paz district. The chief output of the Plomosa district was gold ore from the Julius and Yum Yum properties and silver ore from the R. & A. mine.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord [1]

SUMMARY OUTLINE

The total value of the gold, silver, copper, and lead recovered from ores, old tailings, and gravels in California in 1938—$47,767,894—was greater than that of the metal output in any year since 1856. The continued rise in total value in 1938 was due entirely to the expanding output of gold, as the values of silver, copper, and lead were all less than in 1937 and no zinc was produced in 1938.

Gold increased 12 percent in both quantity and value compared with 1937, whereas silver declined 10 percent in quantity and 25 percent in value; copper, 85 percent in quantity and 88 percent in value; and lead, 58 percent in quantity and 67 percent in value. No zinc output in 1938 was reported, but a small production was made in 1937. The total value of the five metals was 7 percent higher than in 1937; of the total, gold represented 96 percent, silver 3.5 percent, and copper and lead together less than 0.5 percent.

Nevada County continued in 1938 to be the largest contributor to the nonferrous metal wealth of California; it produced 24 percent of the State total value of the four metals, 25 percent of the total lode and placer gold, and 41 percent of the lode gold. Sacramento County (largely from gold dredging) contributed 10 percent of the total value of the four metals; Kern County (largely from gold and gold-silver ores), 8 percent; Amador County (two-thirds from gold ore and one-third from placer gravels), 8 percent; Calaveras County (three-fifths from gold ore and two-fifths from placer gravels), 6 percent; Yuba County (largely from gold dredging), 5 percent; and Merced County (largely from gold dredging), 4 percent. Thus, 7 of the 43 counties producing the metals in California in 1938 supplied two-thirds of the State total.

All tonnage figures are short tons and "dry weight"; that is, they do not include moisture.

[1] The assistance of O. Y. Sharman is acknowledged.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935-38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935-37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in California, 1934–38, and total, 1848–1938, in terms of recovered metals

Year	Mines producing		Ore, old tailings, etc. (short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Fine ounces	Value	Fine ounces	Value
1934	867	1,784	2,356,091	719,063.92	$25,131,284	844,413	$545,883
1935	1,112	1,487	3,337,773	890,430.00	31,165,050	1,191,112	856,112
1936	903	639	4,635,691	1,077,442.00	37,710,470	2,103,799	1,629,392
1937	913	838	4,925,014	1,174,578.00	41,110,230	2,888,265	2,234,073
1938	927	676	4,648,249	1,311,129.00	45,889,515	2,590,804	1,674,863
1848–1938	--------	--------	[1]	95,963,031.00	2,060,809,737	95,919,085	78,361,709

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	569,068	$45,525	823,168	$30,457	721,719	$31,034	$25,784,183
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
1848–1938	[2] 578,009	188,948,592	[2] 120,090	14,143,381	[2] 51,958	9,378,886	2,351,642,305

[1] Figures not available. [2] Short tons.

Gold.—During the 10-year period ended with 1938 the value of the gold output of California increased 438 percent—from $8,526,703 in 1929 to $45,889,515 in 1938; the gain in 1938 over 1937 alone was equivalent to more than half the total value of the output in 1929. In quantity the 1938 gold output was greater than in any year since 1862, and in value it was greater than in any year since 1856. Gold production in 1938 exceeded that in 1937 by 12 percent, whereas production in 1937 exceeded that in 1936 by only 9 percent; this accelerating rate of increase is noteworthy in view of the upward trend that already has continued for 10 years.

Although the 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 1938 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 be higher in 1938 than in any year since 1900. Moreover, it is probable that the placer miners have not enjoyed so productive a year since unrestricted hydraulic mining flourished, over 50 years ago. Even better days for placer mining were anticipated when construction of large débris dams on rivers in the Sierra Nevada Mountains was begun under supervision of the California Débris Commission with River and Harbor Work funds. Early in 1939 the first débris dam, that on the North Fork of American River near Auburn, was completed, making practicable the reopening

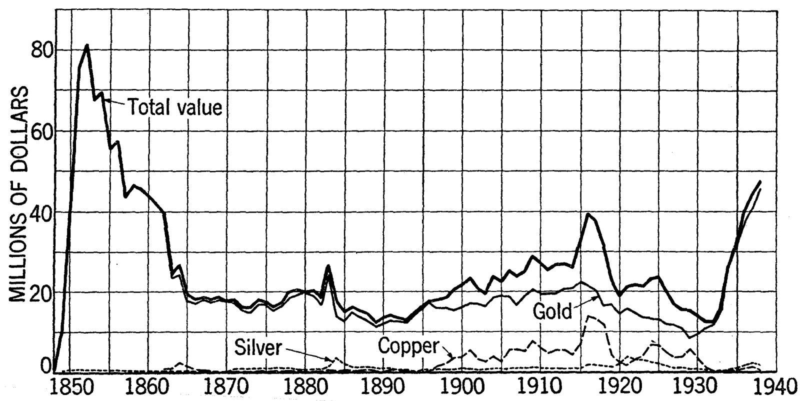

FIGURE 1.—Value of mine production of gold, silver, and copper and total value of gold, silver, copper, lead, and zinc in California, 1848–1938. The value of lead and zinc has exceeded $1,000,000 in only a few years.

of a number of hydraulic mines in the large drainage basin above the dam. Another, the Upper Narrows Dam on Yuba River near Smartville, was projected for construction during 1939.

The 25 leading gold properties, listed in the following table, produced 56 percent of the total gold output of the State in 1938. Newcomers to the list in 1938 were 3 lode mines—the Cactus Queen, the Iron Mountain (which came just short of making the list in 1937), and the Sheepranch—and 4 connected-bucket dredging properties—the Merced dredge No. 1 of the Merced Dredging Co., the Butte Unit of Yuba Consolidated Gold Fields, the San Joaquin dredge No. 1 of the San Joaquin Mining Co., and the Yreka dredge of the Yreka Gold Dredging Co. These operations replaced on the list 4 lode mines and 3 connected-bucket dredging properties that failed to maintain their rank among the leading 25 gold producers in 1938. It will be noted that 12 of the 25 leading in 1938 derived their gold from gold ores, 11 from gravels worked by connected-bucket dredges, and the remaining 2 from gold-silver ores; the producers ranking first, second, and sixth are in the Grass Valley-Nevada City district.

Twenty-five leading gold producers in California in 1938, in approximate order of output

Mine	District	County	Operator	Source of gold
Empire Star mines	Grass Valley-Nevada City.	Nevada	Empire Star Mines Co., Ltd.	Gold ore.
Idaho Maryland	do	do	Idaho Maryland Mines Corporation.	Do.
Natomas Co	Folsom	Sacramento	Natomas Co	Dredge.
Yuba Unit	Yuba River	Yuba	Yuba Consolidated Gold Fields.	Do.
Capital dredge	Folsom	Sacramento	Capital Dredging Co	Do.
Lava Cap	Grass Valley-Nevada City.	Nevada	Lava Cap Gold Mining Corporation.	Gold ore.
Central Eureka and Old Eureka.	Mother Lode	Amador	Central Eureka Mining Co	Do.
Carson Hill	do	Calaveras	Carson Hill Gold Mining Corporation.	Do.
Golden Queen	Mojave	Kern	Golden Queen Mining Co	Do.
Merced Unit	Snelling	Merced	Yuba Consolidated Gold Fields.	Dredge.
Cactus Queen	Mojave	Kern	Cactus Mines Co	Gold - silver ore.
Snelling Unit	Snelling	Merced	Snelling Gold Dredging Co	Dredge.
Iron Mountain	Iron Mountain	Shasta	The Mountain Copper Co., Ltd.	Gold ore.
Merced dredge No. 1	Snelling	Merced	Merced Dredging Co	Dredge.
Yellow Aster	Randsburg	Kern	Anglo American Mining Corporation, Ltd.	Gold ore.
Sheepranch	East Belt	Calaveras	St. Joseph Lead Co	Do.
Argonaut	Mother Lode	Amador	Argonaut Mining Co., Ltd	Do.
Sixteen to One	Alleghany	Sierra	Original Sixteen to One Mine, Inc.	Do.
Big Canyon	West Belt	Eldorado	The Mountain Copper Co., Ltd.	Do.
Arroyo Seco	Mother Lode	Amador	Arroyo Seco Gold Dredging Co.	Dredge.
Starlight	Mojave	Kern	Lodestar Mining Co	Gold - silver ore.
Butte Unit	Oroville	Butte	Yuba Consolidated Gold Fields.	Dredge.
San Joaquin dredge No. 1.	Snelling	Merced	San Joaquin Mining Co	Do.
Cosumnes dredge	Cosumnes River	Sacramento	Cosumnes Gold Dredging Co.	Do.
Yreka dredge	Greenhorn	Siskiyou	Yreka Gold Dredging Co	Do.

Silver.—The bulk of the silver output of California in 1938 was more localized than that of the gold; the 10 leading properties, listed in the following table, produced 82 percent of the total silver. Newcomers to the list in 1938 were the Standard mine at Bodie (Mono County) and the Idaho Maryland mine at Grass Valley (Nevada County), which displaced on the list the Walker mine (Plumas County) and the Spanish mine (Nevada County). Of the 10 leaders, 5 produced gold-silver ores, 4 gold ores, and only 1 straight silver ore. In addition to the yield by the companies listed, some output of silver was reported from almost every lode and placer mine producing in the State in 1938.

Ten leading silver producers in California in 1938, in approximate order of output

Mine	District	County	Operator	Source of silver
Cactus Queen	Mojave	Kern	Cactus Mines Co	Gold-silver ore.
Lava Cap	Grass Valley-Nevada City.	Nevada	Lava Cap Gold Mining Corporation.	Gold ore.
Starlight	Mojave	Kern	Lodestar Mining Co	Gold-silver ore.
Kelly	Randsburg	San Bernardino.	Frank Royer	Do.
Golden Queen	Mojave	Kern	Golden Queen Mining Co.	Gold ore.
Grigsby (Palisade)	Calistoga	Napa	Graham Loftus Oil Corporation.	Gold-silver ore.
Silverado-Kentuck	Mount Patterson	Mono	Sierra Consolidated Mines, Inc.	Silver ore.
Empire Star	Grass Valley-Nevada City.	Nevada	Empire Star Mines Co., Ltd.	Gold ore.
Standard	Bodie	Mono	Roseklip Mines Co	Gold-silver ore.
Idaho Maryland	Grass Valley-Nevada City.	Nevada	Idaho Maryland Mines Corporation.	Gold ore.

Copper.—The production of recoverable copper in California was much smaller in 1938 than in 1937, largely as a result of part-time operation at the Walker mine in the Genesee district of Plumas County. Despite curtailed operations, the Walker mine yielded three-fourths of the copper output of the State during 1938.

Lead.—The small output of recoverable lead in California in 1938 was mined principally in Inyo, Nevada, and Riverside Counties.

Zinc.—No zinc output in California in 1938 was reported.

Gold produced at placer mines in California, 1934–38, 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]					
1934	17	59,210,208	193,773.38	$6,772,380	$0.114
1935	20	75,014,000	236,403.70	8,274,130	.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
Dragline dredges: [3]					
1934	4	604,000	3,466.04	121,138	.201
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
Nonfloating washing plants: [4]					
1934	27	949,000	5,831.48	203,810	.206
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
Gravel hydraulically handled:					
Hydraulic:					
1934	58	1,614,000	9,281.75	324,397	.201
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
Small-scale hand methods: [5]					
Wet:					
1934	1,569	(6)	48,495.54	1,694,919	(6)
1935	1,132	(6)	44,147.24	1,545,153	(6)
1936	326	(6)	39,132.00	1,369,620	(6)
1937	463	2,209,000	25,612.00	896,420	.406
1938	292	2,863,500	41,686.00	1,459,010	.510
Dry:					
1934	13	6,500	183.86	6,426	.989
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

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] In 1934 there were 28 connected-bucket dredges in operation; in 1935, 36; in 1936, 40; in 1937, 46; and in 1938, 48.
[3] Includes all placer operations using dragline-type power shovel for excavating and delivering gravel to floating washing plant. Prior to 1936 no dragline operation had more than one dredge, but in 1936 there were 31 dragline dredges; in 1937, 55; and in 1938, 80.
[4] Includes all placer operations using power excavator and washing plant, both on dry land; when washing plant is movable, outfit is termed "dry-land dredge."
[5] Includes all operations in which hand labor is principal factor in delivering gravel to sluices, long toms, dip boxes, pans, rockers, dry-washers, etc.
[6] Figures not available.

Gold produced at placer mines in California, 1934–38, by classes of mines and by methods of recovery—Continued

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Underground placers:					
Drift:					
1934	96	243,000	12,992.78	$454,098	$1.869
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
Grand total placer:					
1934	1,784	(6)	274,024.83	9,577,168	(6)
1935	1,487	(6)	345,526.00	12,093,410	(6)
1936	639	(6)	409,423.00	14,329,805	(6)
1937	838	120,156,000	472,306.00	16,530,710	.138
1938	676	149,864,000	572,513.00	20,037,955	.134

[6] Figures not available.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals

County	Mines producing[1]: Lode	Mines producing[1]: Placer	Gold: Lode: Fine ounces	Gold: Lode: Value	Gold: Placer: Fine ounces	Gold: Placer: Value	Gold: Total: Fine ounces	Gold: Total: Value
Alpine	1		1	$35			1	$35
Amador	43	28	70,310	2,460,850	36,114	$1,263,990	106,424	3,724,840
Butte	18	38	13,538	473,830	40,244	1,408,540	53,782	1,882,370
Calaveras	55	50	50,390	1,763,650	32,645	1,142,575	83,035	2,906,225
Del Norte		3			20	700	20	700
Eldorado	71	33	36,953	1,293,355	5,470	191,450	42,423	1,484,805
Fresno	3	3	27	945	286	10,010	313	10,955
Humboldt	1	10	19	665	576	20,160	595	20,825
Imperial	15	4	12,791	447,685	23	805	12,814	448,490
Inyo	81	9	17,736	620,760	128	4,480	17,864	625,240
Kern	128	11	85,072	2,977,520	1,631	57,085	86,703	3,034,605
Lassen	2	1	3	105	3	105	6	210
Los Angeles	12	10	4,509	157,815	397	13,895	4,906	171,710
Madera	14	14	76	2,660	195	6,825	271	9,485
Mariposa	70	17	23,497	822,395	7,412	259,420	30,909	1,081,815
Merced		5			59,724	2,090,340	59,724	2,090,340
Modoc	1		23	805			23	805
Mono	20	1	3,353	117,355	1	35	3,354	117,390
Monterey	1	1	57	1,995	4	140	61	2,135
Napa	1		1,836	64,260			1,836	64,260
Nevada	30	29	300,733	10,525,655	21,025	735,875	321,758	11,261,530
Orange	1	1	1	35	6	210	7	245
Placer	26	67	19,772	692,020	31,827	1,113,945	51,599	1,805,965
Plumas	25	34	16,267	569,345	3,679	128,765	19,946	698,110
Riverside	25	5	2,092	73,220	108	3,780	2,200	77,000
Sacramento	2	15	130	4,550	141,974	4,969,090	142,104	4,973,640
San Bernardino	94	11	10,920	382,200	774	27,090	11,694	409,290
San Diego	5	3	82	2,870	6	210	88	3,080
San Francisco		(2)			74	2,590	74	2,590
San Joaquin		2			1,188	41,580	1,188	41,580
San Luis Obispo		1			215	7,525	215	7,525
Santa Clara	1		1	35			1	35
Santa Cruz		(2)			10	350	10	350
Shasta	30	36	21,388	748,580	19,744	691,040	41,132	1,439,620
Sierra	20	38	20,989	734,615	4,739	165,865	25,728	900,480
Siskiyou	37	80	5,286	185,010	31,692	1,109,220	36,978	1,294,230
Stanislaus		6			12,950	453,250	12,950	453,250
Tehama		1			2,112	73,920	2,112	73,920
Trinity	24	64	1,020	35,700	40,447	1,415,645	41,467	1,451,345
Tulare	5	2	15	525	25	875	40	1,400
Tuolumne	56	21	13,532	473,620	10,882	380,870	24,414	854,490
Ventura	1		19	665			19	665
Yuba	8	22	6,178	216,230	64,163	2,245,705	70,341	2,461,935
	927	676	738,616	25,851,560	572,513	20,037,955	1,311,129	45,889,515
Total, 1937	913	838	702,272	24,579,520	472,306	16,530,710	1,174,578	41,110,230

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.
[2] Not reported.

Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals—Continued

County	Silver					
	Lode		Placer		Total	
	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Alpine	167	$108			167	$108
Amador	18,371	11,876	4,165	$2,693	22,536	14,569
Butte	27,557	17,815	2,868	1,854	30,425	19,669
Calaveras	15,258	9,864	2,393	1,547	17,651	11,411
Del Norte			2	1	2	1
Eldorado	8,111	5,243	733	474	8,844	5,717
Fresno	5	3	49	32	54	35
Humboldt	6	4	83	54	89	58
Imperial	4,330	2,799	1	1	4,331	2,800
Inyo	41,095	26,566	23	15	41,118	26,581
Kern	1,148,080	742,193	97	63	1,148,177	742,256
Lassen	28	18			28	18
Los Angeles	1,819	1,176	68	44	1,887	1,220
Madera	31	20	55	36	86	56
Mariposa	6,969	4,505	1,004	649	7,973	5,154
Merced			5,859	3,788	5,859	3,788
Modoc	24	16			24	16
Mono	220,978	142,854			220,978	142,854
Monterey	3	2	2	1	5	3
Napa	148,337	95,895			148,337	95,895
Nevada	502,334	324,741	2,822	1,824	505,156	326,565
Orange	679	439	3	2	682	441
Placer	38,588	24,946	4,638	2,998	43,226	27,944
Plumas	53,528	34,604	399	258	53,927	34,862
Riverside	5,214	3,371	24	16	5,238	3,387
Sacramento	23	15	6,213	4,016	6,236	4,031
San Bernardino	257,327	166,353	43	28	257,370	166,381
San Diego	31	20			31	20
San Francisco			5	3	5	3
San Joaquin			92	59	92	59
San Luis Obispo			5	3	5	3
Santa Clara	1	1			1	1
Santa Cruz			2	1	2	1
Shasta	27,357	17,685	1,414	914	28,771	18,599
Sierra	4,306	2,784	503	325	4,809	3,109
Siskiyou	674	436	4,485	2,899	5,159	3,335
Stanislaus			1,332	861	1,332	861
Tehama			161	104	161	104
Trinity	253	164	4,375	2,828	4,628	2,992
Tulare	13	8	6	4	19	12
Tuolumne	5,451	3,524	1,578	1,020	7,029	4,544
Ventura	5	3			5	3
Yuba	4,063	2,626	4,286	2,771	8,349	5,397
	2,541,016	1,642,677	49,788	32,186	2,590,804	1,674,863
Total, 1937	2,847,784	2,202,761	40,481	31,312	2,888,265	2,234,073

Mine production of gold, silver, copper, lead, and zinc in California in 1938, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Alpine							$143
Amador	4,000	$392					3,739,801
Butte							1,902,039
Calaveras	20,000	1,960	2,000	$92			2,919,688
Del Norte							701
Eldorado	42,000	4,116	2,000	92			1,494,730
Fresno							10,990
Humboldt							20,883
Imperial	70,000	6,860					458,150
Inyo	62,000	6,076	392,000	18,032			675,929
Kern			4,000	184			3,777,045
Lassen							228
Los Angeles	2,000	196					173,126
Madera							9,541
Mariposa	4,000	392					1,087,361
Merced							2,094,128
Modoc							821
Mono	4,000	392	4,000	184			260,820
Monterey							2,138
Napa	4,000	392					160,547
Nevada	124,000	12,152	296,000	13,616			11,613,863
Orange			2,000	92			778
Placer	6,000	588	16,000	736			1,835,233
Plumas	1,204,000	117,992	2,000	92			851,056
Riverside	14,000	1,372	234,000	10,764			92,523
Sacramento							4,977,671
San Bernardino	44,000	4,312	26,000	1,196			581,179
San Diego	6,000	588					3,688
San Francisco							2,593
San Joaquin							41,639
San Luis Obispo							7,528
Santa Clara							36
Santa Cruz							351
Shasta			2,000	92			1,458,311
Sierra			8,000	368			903,957
Siskiyou							1,297,565
Stanislaus							454,111
Tehama							74,024
Trinity							1,454,337
Tulare							1,412
Tuolumne	2,000	196					859,230
Ventura							668
Yuba							2,467,332
	1,612,000	157,976	990,000	45,540			47,767,894
Total, 1937	10,502,000	1,270,742	2,372,000	139,948	40,000	$2,600	44,757,593

Ore treated and gold and silver recovered at gold mills in the Mother Lode counties in California in 1938 [1]

County	Ore treated	Gold and silver recovered in bullion			Concentrates produced [2]	Gold and silver recovered from concentrates smelted			Value of total recovery	
		Gold	Silver	Average value per ton of ore		Gold	Silver	Average value per ton of concentrates	Total	Average value per ton of ore
	Short tons	*Fine ounces*	*Fine ounces*		*Short tons*	*Fine ounces*	*Fine ounces*			
Amador	190,790	47,810	10,312	$8.81	2,257	8,941	3,410	$139.63	$1,995,156	$10.46
Calaveras	518,626	37,944	8,809	2.57	2,873	11,834	5,227	145.34	1,751,304	3.38
Eldorado	61,016	18,574	2,983	10.69	1,347	5,743	1,069	149.74	853,714	13.99
Mariposa	100,520	11,411	3,083	3.99	2,078	11,921	3,744	201.95	821,033	8.17
Tuolumne	60,700	6,407	1,495	3.71	692	1,885	1,778	97.00	292,336	4.82
	931,652	122,146	26,682	4.61	9,247	40,324	15,228	153.69	5,713,543	6.13
Total, 1937	1,064,908	113,995	29,154	3.77	10,116	33,943	12,361	118.38	5,209,943	4.89

[1] Old tailings and mill cleanings excluded.
[2] Includes only concentrates recovered from gold ore.

MINING INDUSTRY

The decrease in combined value of the output of copper, lead, and zinc more than offset the net increase in combined value of the output of lode gold and silver in California in 1938; the total value of the output of the five metals from lode mines was equivalent to 98 percent of that in 1937. It was the placer-mining section of the industry that was responsible for the rising total value of the output of the five metals in 1938; the value of placer production increased 21 percent compared with 1937. In 1938, 44 percent of the State gold output was recovered at placer mines compared with 40 percent in the preceding year.

Dredges of the connected-bucket type handled 78 percent of the gravel mined and recovered 66 percent of the placer gold in 1938—a very small decline from the proportion of the total gravel handled and the total gold recovered by this method in 1937.

The second most important method—dragline dredging [2]—continued its spectacular rise as a means of recovering placer gold. The first dragline dredge production in the United States was reported in California in 1933, when two outfits, starting work late in the year, recovered less than 100 ounces of gold. In 1938, 77 operations were working 80 outfits; they treated 16 percent of the yardage and recovered 21 percent of the gold produced at placer mines. A small but progressive decline in the average value of gold recovered per cubic yard by dragline dredges has been noted since 1934, whereas the average recovered by connected-bucket dredges has varied little; in 1938 the average recovery per yard by dragline was $0.056 higher than the average ($0.112) by connected-bucket dredges.

Nonfloating washing plants to which gravel was delivered by mechanical means showed a large increase in yardage handled in 1938 over 1937, but the average gold recovered from the material treated continued to decline from the average in 1935 to 1937. Some of these nonfloating washing plants were stationary; others were built to move on skids, wheels, tracks, or by other means. Dragline excavators, power shovels, slack-line excavators, trucks, and other machines were used in delivering the gravel to these washing plants.

Small-scale hand methods, described in a recent report,[3] showed a substantial increase in 1938 over 1937, due perhaps to continuance of industrial unemployment.

Increases in yardage treated and gold recovered in 1938 at hydraulic mines but small decreases at drift mines were reported.

ORE CLASSIFICATION

Of the 4,648,249 tons of ore (including 988,330 tons of old tailings) sold or treated in 1938, 94 percent was dry and siliceous gold ore, 4 percent dry and siliceous gold-silver ore, and most of the remainder copper ore. In 1937 there was a much larger proportion of copper ore and more silver ore and a smaller proportion of gold ore and gold-silver ore.

[2] Merrill, Charles White, Dragline Dredges—A New Way to Mine Placer Gold: Min. and Met., December 1938, pp. 521–525.
Gardner, E. D., and Allsman, Paul T., Power-Shovel and Dragline Placer Mining: Bureau of Mines Inf. Circ. 7013, 1938, 68 pp.

[3] Merrill, Charles White, Henderson, Chas. W., and Kiessling, O. E., Small-Scale Placer Mines as a Source of Gold, Employment, and Livelihood in 1935: Mineral Technology and Output-per-Man Studies, W. P. A. National Research Project Rept. E–2, May 1937, 28 pp.

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 1938, with content in terms of recovered metals

Source	Material sold or 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	3,408,735	977,917	700,256	980,568	358,000	648,300	--------
Dry and siliceous gold-silver ore	181,006	2,912	35,496	1,325,777	32,200	100	--------
Dry and siliceous silver ore	2,391	7,501	144	169,131	4,300	3,300	--------
	3,592,132	988,330	735,896	2,475,476	394,500	651,700	--------
Copper ore	66,943	-----------	2,295	47,016	1,209,600	500	--------
Lead ore	844	-----------	425	18,524	7,900	337,800	--------
Total, lode mines	3,659,919	988,330	738,616	2,541,016	1,612,000	990,000	--------
Total, placers	-----------	-----------	572,513	49,788	-----------	-----------	--------
	3,659,919	988,330	1,311,129	2,590,804	1,612,000	990,000	--------
Total, 1937	3,640,467	1,284,547	1,174,578	2,888,265	10,502,000	2,372,000	40,000

METALLURGIC INDUSTRY

During 1938, as in former years, the bulk of the ore and virtually all the old tailings were treated at amalgamation and cyanidation mills (with or without concentration equipment); 70 percent of the total ore and 91 percent of the combined ore and old tailings were treated at such mills in 1938. Almost all the remaining ore and all the rest of the old tailings were treated at concentrating mills. A total of 12,750 tons of ore was shipped for direct smelting. Comparing 1938 with 1937 there was an increase of 11 percent in ore and a decrease of 23 percent in old tailings treated at gold and silver mills; the total ore and old tailings so treated in the 2 years varied less than 1 percent. The quantity of material treated in 1938 at concentrating mills decreased 43 percent and the quantity of crude ore smelted 46 percent. The decrease in quantity of concentrates shipped in 1938 for smelting was due in part to limited operations at the Walker mine in Plumas County, which made very large shipments of copper concentrates in 1937. The dry gold concentrates shipped in 1938 were of higher grade than those shipped in 1937.

Most companies mining in California in 1938 owned and operated their own metallurgical plants, but a number of custom mills also were operated in the State. The leading operators of metallurgical plants receiving custom material were the Idaho Maryland Mines Corporation, Grass Valley, Nevada County (cyanidation of ore and concentrates); Amador Metals Reduction Co., Jackson, Amador County (cyanidation of concentrates); Burton Bros., Inc., Rosamond, Kern County (cyanidation of ores); Western Graphite Co., Lake Hughes, Los Angeles County (flotation of ore); Golden Queen Mining Co., Mojave, Kern County (cyanidation of ore); and Keeler Gold Mines, Inc., Keeler, Inyo County (cyanidation of ore). During 1938 the Amador Metals Reduction Co. and Western Graphite Co. ceased operations, and by the end of the year their plants had been dismantled. It is interesting to note that these two plants were the only ones in the group that did not derive part of the material treated from mines managed by their operators. 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., Selby, Contra Costa County.

Mine production of metals in California in 1938, 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	2,548,159	337,514	63,930			
Ore, old tailings, sands, slimes, and concentrates cyanided	2,382,255	232,113	891,087			
Concentrates smelted:						
Flotation	35,425	146,917	1,298,406	1,532,200	625,000	
Gravity	2,477	11,745	16,049	9,200	15,600	
Ore smelted	12,750	10,327	271,544	70,600	349,400	
Total, lode mines		738,616	2,541,016	1,612,000	990,000	
Total, placers		572,513	49,788			
		1,311,129	2,590,804	1,612,000	990,000	
Total, 1937		1,174,578	2,888,265	10,502,000	2,372,000	40,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1938, 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	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	190,682	500	48,936	9,799	2,257	8,941	3,410	4,000	
Butte	72,424		3,827	3,711	1	2	1		
Calaveras	518,600	350	22,689	2,823	2,873	11,834	5,227	5,600	2,000
Eldorado	41,195	50	14,972	2,392	1,346	5,736	1,068	5,800	
Fresno	29		27	5					
Humboldt	35		19	6					
Imperial	1		6	2					
Inyo	6,331	105	1,245	288	5	59	229		
Kern	209,382	1,129	17,065	5,008	40	165	95		200
Lassen	4		2	1					
Los Angeles	10,657	1,800	3,330	721	182	903	757	2,000	
Madera	314		73	31					
Mariposa	100,490	60	11,206	2,791	2,078	11,921	3,744	4,000	
Modoc	400		20	14	1	3	10		
Mono	5,162		925	408	2	5	21		
Monterey	120		20	1	4	37	2		
Nevada	1,023,602		159,654	24,499	6,929	33,908	306,441	41,600	67,700
Placer	106,613	2,646	14,748	4,056	755	3,537	31,645	4,300	16,000
Plumas	34,977		3,115	618	81	1,504	267		
Riverside	4,343	22	1,404	442	27	112	37		
Sacramento	1		127	21					
San Bernardino	3,551	85	974	267	35	671	7,036	300	8,900
San Diego	98		29	7					
Santa Clara	1		1	1					
Shasta	9,845		2,848	679	125	1,085	329		1,400
Sierra	52,196	1,000	18,582	3,387	350	1,370	455		
Siskiyou	83,868		4,774	532	179	386	62		
Trinity	3,482		771	152	3	32	22		
Tulare	73		13	5					
Tuolumne	52,541	5,897	5,713	1,204	692	1,885	1,778	1,000	
Ventura	75		18	4	1	1	1		
Yuba	2,557	866	381	55	3	14	2		
	2,533,649	14,510	337,514	63,930	17,969	84,111	362,639	68,600	96,200
Total, 1937	2,383,152	59,752	370,004	214,639	20,339	82,261	311,380	82,900	137,400

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in California in 1938, 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	1,134	544,653	12,290	5,090					
Butte	25,400		7,614	18,397	187	2,049	5,438		
Calaveras	380,105		15,265	5,991					
Eldorado	19,821		3,604	592	1	7	1		
Imperial	12,566	6,680	4,892	1,223					
Inyo	25,144	7,530	6,525	16,185	7	11	49		
Kern	219,914	379,607	49,893	605,924	188	12,811	530,460		
Los Angeles	1		1	1					
Madera		133	3						
Mariposa	97	3,015	360	418					
Mono	65,297	800	2,255	66,680					
Nevada	372,004	12,950	99,035	120,686	2,361	3,566	38,687	81,300	222,700
Placer	5,616		871	2,064					
Plumas	5	1,671	76	54					
Riverside	509		154	31	1	1			
San Bernardino	14,583	10,727	6,211	17,515	1	7	8		
San Diego	15		25	12					
Shasta	260,003		16,097	25,774	11	221	208		
Sierra	1,121		150	10	18	61	39		
Siskiyou	233	1,179	113	69					
Trinity	80	500	151	61					
Tuolumne	8,159		749	308					
Yuba	1,003		5,779	4,002					
	1,412,810	969,445	232,113	891,087	2,775	18,734	574,890	81,300	222,700
Total, 1937	952,132	1,219,326	176,292	724,360	2,604	6,931	149,604	89,800	238,500
Grand total: 1938	3,946,459	983,955	569,627	955,017	20,744	102,845	937,529	149,900	318,900
1937	3,335,284	1,279,078	546,296	938,999	22,943	89,192	460,984	172,700	375,900

[1] Ore figures include sands, slimes, and concentrates cyanided.

Mine production of metals from concentrating mills in California in 1938, 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*
Amador	90		11	27	14		
Butte	60		6	30	7		
Calaveras	700		70	38	699	14,300	
Eldorado	85,116		5,901	12,603	4,040	36,200	2,000
Imperial	54,155		1,192	7,773	3,054	69,900	
Inyo	39,844		1,699	9,006	7,549	51,100	69,100
Kern	36,479		669	5,024	5,185		3,800
Los Angeles	291		30	274	338		
Mono	2,270		227	167	147,676	3,400	
Napa	4,020		402	1,836	148,337	4,000	
Nevada	4,069		117	1,003	469	700	5,100
Plumas	112,350		4,848	11,298	51,729	1,197,100	900
Riverside	2,085	4,375	253	346	4,613	13,600	232,700
San Bernardino	3,114		264	379	588	200	100
Shasta	390		38	103	100		
Sierra	5,030		236	823	415		8,000
Tuolumne	29,572		1,195	5,087	2,113	1,000	
	379,635	4,375	17,158	55,817	376,926	1,391,500	321,700
Total, 1937	667,208	5,469	31,293	58,138	963,165	10,107,000	96,500

Gross metal content of concentrates produced from ores mined in California in 1938, by classes of concentrates

Class of concentrates	Concentrates	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry gold	33,005	145,258	951,030	322,278	373,259
Dry gold-silver	407	1,849	149,145	6,357	----------
Dry silver	220	126	147,642	4,429	----------
Copper	3,695	10,032	50,311	1,318,430	1,735
Lead	328	1,055	11,717	7,865	87,226
Lead-copper	247	342	4,610	18,616	242,246
	37,902	158,662	1,314,455	1,677,975	704,466
Total, 1937	54,236	147,330	1,424,149	10,699,831	522,936

Mine production of metals from California concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Amador	2,268	8,968	3,424	4,000	----------
Butte	194	2,081	5,446	----------	----------
Calaveras	2,943	11,872	5,926	19,900	2,000
Eldorado	7,248	18,346	5,109	42,000	2,000
Imperial	1,192	7,773	3,054	69,900	----------
Inyo	1,711	9,076	7,827	51,100	69,100
Kern	897	18,000	535,740	----------	4,000
Los Angeles	212	1,177	1,095	2,000	----------
Mariposa	2,078	11,921	3,744	4,000	----------
Modoc	1	3	10	----------	----------
Mono	229	172	147,697	3,400	----------
Monterey	4	37	2	----------	----------
Napa	402	1,836	148,337	4,000	----------
Nevada	9,407	38,477	345,597	123,600	295,500
Placer	755	3,537	31,645	4,300	16,000
Plumas	4,929	12,802	51,996	1,197,100	900
Riverside	281	459	4,650	13,600	232,700
San Bernardino	300	1,057	7,632	500	9,000
Shasta	174	1,409	637	----------	1,400
Sierra	604	2,254	909	----------	8,000
Siskiyou	179	386	62	----------	----------
Trinity	3	32	22	----------	----------
Tuolumne	1,887	6,972	3,891	2,000	----------
Ventura	1	1	1	----------	----------
Yuba	3	14	2	----------	----------
	37,902	158,662	1,314,455	1,541,400	640,600
Total, 1937	54,236	147,330	1,424,149	10,279,700	472,400

BY CLASSES OF CONCENTRATES

Dry gold	33,005	145,258	951,030	235,900	323,900
Dry gold-silver	407	1,849	149,145	4,000	----------
Dry silver	220	126	147,642	3,400	----------
Copper	3,695	10,032	50,311	1,278,300	900
Lead	328	1,055	11,717	6,200	83,100
Lead-copper	247	342	4,610	13,600	232,700
	37,902	158,662	1,314,455	1,541,400	640,600

Gross metal content of California crude ore shipped to smelters in 1938, 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	5,618	8,178	18,586	26,494	7,310	
Dry and siliceous gold-silver	5,987	1,638	224,932	17,712		
Dry and siliceous silver	173	3	9,069	973	4,419	
Copper	121	68	128	22,480	2,394	
Lead	851	440	18,829	11,680	354,323	
	12,750	10,327	271,544	79,339	368,446	
Total, 1937	23,785	8,646	484,636	244,001	1,994,370	43,588

Mine production of metals from California crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Alpine	1	1	167			
Amador	44	116	58			
Butte	16	16	3			
Calaveras	376	564	518	100		
Eldorado	42	31	18			
Imperial	302	120	51	100		
Inyo	1,685	890	16,795	10,900	322,900	
Kern	93	114	1,408			
Lassen	1	1	27			
Los An eles	3	1	2			
Mariposa	8	10	16			
Mono	20	1	6,193	600	4,000	
Nevada	82	3,567	11,552	400	500	
Orange	4	1	679		2,000	
Placer	461	616	823	1,700		
Plumas	432	274	860	6,900	1,100	
Riverside	75	75	91	400	1,300	
Sacramento	1	3	2			
San Bernardino	8,776	2,678	231,913	43,500	17,000	
San Diego	30	28	12	6,000		
Shasta	183	1,034	267		600	
Sierra	1	3				
Siskiyou	11	13	11			
Trinity	4	66	18			
Tulare	5	2	8			
Tuolumne	88	98	48			
Yuba	6	4	4			
	12,750	10,327	271,544	70,600	349,400	
Total, 1937	23,785	8,646	484,636	222,300	1,899,600	40,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	5,618	8,178	18,586	24,400	6,900	
Dry and siliceous gold-silver	5,987	1,638	224,932	16,800		
Dry and siliceous silver	173	3	9,069	900	3,300	
Copper	121	68	128	20,400	500	
Lead	851	440	18,829	8,100	338,700	
	12,750	10,327	271,544	70,600	349,400	

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in California in 1938, 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*	
Alpine County: Monitor	1		1	1		1	167			$143
Amador County:										
East Belt [4]	11	7	10,425	1,221	1,591	2,812	2,161	1,300		99,944
Ione		9			26,453	26,453	2,965			927,772
Mother Lode [5]	32	11	725,652	69,089	3,962	73,051	16,966	2,700		2,568,018
Butte County:										
Butte Creek	(6)	5	(6)	(6)	1,506	[8] 1,506	[8] 155			52,810
Cherokee	1		9	3		3	1			106
Enterprise		1			9	9	1			316
Forbestown	(6)	(7)	(6)	(6)	20	[8] 20	[8] 2			[8] 701
Golden Summit		1			3,002	3,002	120			105,148
Inskip	1		110	7		7	2			246
Magalia	1	7	487	61	1,391	1,452	196			50,947
Merrimac	1	2	170	108	6	114	46			4,020
Oroville	5	18	565	82	33,931	34,013	2,388			1,191,999
Paradise		1			3	3	1			106
Stirling City	1	(6)	18	3	(6)	[9] 3	[9] 1			[9] 106
Yankee Hill	5	1	24,437	4,991	6	4,997	9,002			180,714
Calaveras County:										
Camanche [10]		10			12,660	12,660	1,092			443,806
Campo Seco	2	8	312	9	2,352	2,361	651	11,400		84,173
Copperopolis	7	(7)	41,463	4,835	47	4,882	4,038	1,000		173,578
East Belt [4]	21	3	48,093	14,410	203	14,613	2,275	2,600		513,181
Jenny Lind	5	5	734	92	10,578	10,670	625	2,900		374,138
Mother Lode [5]	20	24	429,450	31,044	6,805	37,849	8,970	2,100	2,000	1,330,812
Del Norte County:										
French Hill		2			16	16	1			560
Monumental		1			4	4	1			141
Eldorado County:										
East Belt [4]	8	4	1,030	577	317	894	344			31,512
Mother Lode [5]	51	25	66,085	20,901	1,508	22,409	3,211	5,400		786,920
West Belt	12	4	105,409	15,475	3,645	19,120	5,289	36,600	2,000	676,298

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in California in 1938, 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	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Fresno County:										
Copper King	1		8	14		14				$490
Friant		2			284	284	49			9,972
Mill Creek	1		6	3		3				105
Sycamore		1			2	2				70
Temperance Flat	1		15	10		10	5			353
Humboldt County:										
Gold Bluff		1			11	11				385
Orleans	1	5	35	19	528	547	85			19,200
Trinity River		4			37	37	4			1,298
Imperial County:										
Cargo Muchacho	13	2	73,671	12,772	6	12,778	4,322	70,000		456,884
Mesquite	1	(7)	1	6	13	19	3			667
Picacho	1	2	32	13	4	17	6			599
Inyo County:										
Carbonate	6		1,130	509		509	2,685	5,200	57,100	22,687
Casa Diablo	1		24	17		17	20			608
Cerro Gordo	7		6,961	750		750	9,312	300	24,500	33,426
Chidago [11]	1		36,468	8,580		8,580	2,485	45,700		306,385
Chloride Cliff	4		83	53		53	146		2,000	2,041
Coso	16	2	1,904	210	65	275	1,199			10,400
Darwin	5		1,550	24		24	7,228	1,800	137,200	12,000
Echo Canyon	1		1,500	309		309	37			10,839
Fish Springs	5		452	105		105	53			3,709
Furnace Creek	1		24	20		20				700
Kearsarge	1		3	1		1	15			45
Marble Canyon		7			63	63	4			2,208
Mt. Argus	2		2,463	439		439	23			15,380
Russ	6		197	21		21	4,178	600	3,100	3,637
Sherwin	1		40	17		17	71			641
South Park	8		18,940	4,540		4,540	448	2,300	1,000	159,461
Ubehebe	4		156	21		21	1,188			1,503
Union	1		1,504	1,201		1,201	5,912	700	73,100	49,288
White Mountain	1		66	76		76	31			2,680
Wild Rose	8		1,500	345		345	1,611		24,900	14,262
Kern County:										
Agua Caliente	4		2,332	226		226	108			7,980
China Grade		1			72	72	13			2,528
Cove	2		38,410	4,943		4,943	4,915		4,000	176,366
Goler		2			75	75	20			2,638

Greenhorn	1		4	1		1	1			36
Green Mountain	7		850	304		304	170			10,750
Havilah	10	1	874	198	1	199	195			7,091
Long Tom	2	1	110	54	3	57	23			2,010
Mojave	34		219,326	61,933		61,933	1,135,659			2,901,819
Pioneer	12	1	677	113	2	115	128			4,108
Rademacher	7		176	125		125	156			4,476
Randsburg [12]	39	3	582,211	17,031	1,248	18,279	5,266			643,169
Red Rock	2		1,434	76		76	1,464			3,606
Sageland	6	(7)	103	39	27	66	36			2,333
Tehachapi	2	1	95	29	2	31	8			1,090
Woody		1			201	201	15			7,045
Lassen County:										
Hayden Hill	1		1	1		1	27			52
Honey Lake	1	1	4	2	3	5	1			176
Los Angeles County:										
Cedar	4		12,228	4,216		4,216	1,475	2,000		148,710
Neenach	3		284	271		271	336			9,702
San Gabriel	2	5	57	5	386	391	70			13,730
Saugus	2	5	8	3	11	14	2			491
Valyermo	1		175	14		14	4			493
Madera County:										
Hildreth	3	4	11	6	26	32	14			1,129
Potter Ridge	11	9	436	70	162	232	70			8,165
Mariposa County:										
Colorado	5	1	689	518	1	519	90			18,223
Hites Cove	1		617	48		48	15			1,690
Hunter Valley	11	(6)	11,657	8,151	(6)	[9] 8,151	[9] 2,858	2,200		[9] 287,348
Mother Lode [5]	45	14	74,373	12,089	7,404	19,493	4,517	1,800		685,351
Whitlock	8		16,267	2,691		2,691	493			94,504
Merced County: Snelling		5			59,724	59,724	5,859			2,094,128
Modoc County: High Grade	1		400	23		23	24			821
Mono County:										
Bodie	5		66,679	2,305		2,305	66,701			123,795
Chidago [11]	6		197	55		55	49			1,957
Dunderberg	1		30	5		5	2			176
Masonic	2		980	200		200	185			7,120
Mono Lake	1		1	1		1				35
Mount Patterson	1		2,200	126		126	147,642	3,400		100,189
Piute	1		30	3		3	1			106
White Mountains	1		20	1		1	6,193	600	4,000	4,281
Monterey County: Los Burros	1	1	120	57	4	61	5			2,138
Napa County: Calistoga	1		4,020	1,836		1,836	148,337	4,000		160,547
Nevada County:										
French Corral		3			553	553	60			19,394
Grass Valley-Nevada City	23	10	1,040,079	296,132	13,753	309,885	459,317	42,700	73,300	11,150,463
North San Juan		2			7	7				245
Washington	7	7	23,624	4,601	6,101	10,702	45,710	81,300	222,700	422,331
You Bet		7			611	611	69			21,430

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in California in 1938, 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	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Orange County:										
San Juan Capistrano		1			6	6	3			$212
Santa Rosa	1		4	1		1	679		2,000	566
Placer County:										
Auburn	4	2	468	165	3,445	3,610	545			126,702
Butcher Ranch	([6])	2	([6])	([6])	17	[8] 17	[8] 3			[8] 597
Colfax	1	([7])	2,646	194	8	202	34			7,092
Damascus		1			101	101	5			3,538
Dutch Flat	([6])	2	([6])	([6])	496	[8] 496	[8] 47			[8] 17,390
Foresthill	6	4	1,038	264	448	712	96			24,982
Iowa Hill		13			898	898	103			31,497
Last Chance	1	7	126	21	194	215	27			7,542
Lincoln		9			9,752	9,752	1,648			342,385
Michigan Bluff		5			118	118	10			4,136
Ophir	11	20	82,713	15,124	16,320	31,444	40,144	6,000	16,000	1,127,816
Plumas County:										
Bucks Lake	1		50	30		30	7			1,055
Butte Valley	2		258	38		38	3,750		900	3,796
Clear Creek	1		10	1		1	1			36
Crescent Mills	6	9	32,228	3,956	741	4,697	1,196	6,900		165,844
Granite Basin	1	1	30	24	462	486	71		100	17,060
Johnsville	4	2	445	256	116	372	160		1,000	13,169
La Porte	1	5	216	30	963	993	87			34,811
Lights Canyon		1			65	65	10			2,281
Quincy	4	10	3,557	517	535	1,052	124			36,900
Rich Bar	([6])	4	([6])	([6])	779	[8] 779	[8] 81			[8] 27,317
Seneca	1		40	20		20	3			702
Wolf Creek	2	([6])	747	157	([6])	[9] 157	[9] 38			[9] 5,520
Riverside County:										
Chuckawalla	3	([7])	2,215	454	31	485	202	200	300	17,139
Dale [13]	8	([6])	678	210	([6])	[9] 210	[9] 75			[9] 7,398
Eagle Mountain	3	1	6,468	363	5	368	4,643	13,800	233,700	27,984
Ironwood	2		430	118		118				4,130
Morongo [14]	1		4	7		7				245
Mt. Beauty	1		120	2		2	1			71
Pinacate	3	2	1,300	870	69	939	275			33,043
Pinon	4		194	68		68	41			2,407
Sacramento County:										
Cosumnes River		3			17,088	17,088	1,046			598,755
Folsom	1	11	1	3	124,885	124,888	5,169			4,374,422

Michigan Bar		1			1	1				35
Wall Town	1		1	127		127	21			4,459
San Bernardino County:										
Black Hawk	1		1	1		1	3			37
Buckeye	3		1,523	374		374	1,850	18,000	200	16,059
Calico	7		7,278	16		16	11,477		1,000	8,025
Coolgardie		(7)			4	4				140
Dale[13]	6		13,946	6,087		6,087	11,865	500	8,900	221,174
Dry Lake	3		984	199		199	54			7,000
Fremont Peak	1		639	43		43	8			1,510
Goldstone	10	(7)	366	185	3	188	198			6,708
Grapevine	1		5				6	700		72
Halloran Springs	5	1	1,963	614	3	617	597	700		22,050
Hikorum	1		32	5		5	25	4,100		593
Holcomb Valley		5			181	181	24			6,351
Ibex	1		2	5		5	1			176
Ivanpah	6		2,970	277		277	4,099	300	200	12,383
Kelso	1		25	9		9	34			337
Kingston Mountain	1		45	4		4	138		15,300	933
Kramer Hills	1		15	7		7	2			246
Morongo[14]	2		86	6		6				210
Myrick	1		45	4		4	1			141
Needles	3		59	14		14				490
Old Woman Mountain	4		3,332	790		790	144	100		27,753
Ord Mountain	1		70	64		64	28	400		2,297
Paradise		1			3	3				105
Providence	3		36	5		5	201			305
Randsburg[12]	8	4	6,303	1,714	580	2,294	224,871	16,800		227,308
Shadow Mountains	1		200	3		3	2			106
Signal	2		19	56		56	12			1,968
Silver Mountain	8		457	255		255	1,318		200	9,786
Slate Range	2		58	24		24	157		100	946
Turtle Mountain	4		263	113		113	51	500		4,037
Vanderbilt	2		4	3		3	200		100	239
Whipple Mountain	3		57	35		35	3	1,600		1,384
San Diego County:										
Ballena		1			1	1				35
De Luz	1		20	4		4	2			141
Julian	3	1	103	43	3	46	14	6,000		2,207
Ramona		1			2	2				70
San Francisco County: San Francisco		(7)			74	74	5			2,593
San Joaquin County:										
Camanche[10]		1			18	18	3			632
Linden		1			329	329	22			11,529
Wallace		(7)			841	841	67			29,478
San Luis Obispo County: Oro Fino		1			215	215	5			7,528
Santa Clara County: Lexington	1		1	1		1	1			36
Santa Cruz County: Santa Cruz		(7)			10	10	2			351

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in California in 1938, 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	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Shasta County:										
Centerville	(6)	3	(6)	(6)	35	[8] 35	[8] 2			[8] $1,226
French Gulch	14	6	6,180	2,856	594	3,450	782		2,000	121,348
Igo	3	18	36	14	18,777	18,791	1,315			658,535
Redding	1	3	3,000	1,528	26	1,554	441			54,675
Shasta	8	4	1,126	653	146	799	239			28,120
Sierra County:										
Alleghany	9	12	51,263	19,261	3,304	22,565	4,112			792,433
Brandy City		1			12	12	2			421
Downieville	5	15	5,934	911	1,044	1,955	556		8,000	69,152
Gold Lake		1			6	6	1			211
Pike	1	3	120	182	29	211	54			7,420
Poker Flat		1			29	29	3			1,017
Port Wine		2			54	54	3			1,892
Sierra City	5	2	1,910	635	29	664	60			23,279
Siskiyou County:										
Callahan	2	7	100	25	10,622	10,647	1,397			373,548
Greenhorn	(6)	5	(6)	(6)	14,535	[8] 14,535	[8] 2,155			[8] 510,118
Humbug	2	3	155	13	706	719	119			25,242
Klamath River	12	30	2,404	259	3,329	3,588	565			125,945
Liberty	5	22	81,720	4,422	1,372	5,794	602			203,179
Salmon River	4	6	435	237	689	926	146			32,504
Scott River	11	7	457	304	439	743	169			26,114
Stanislaus County:										
Knights Ferry		3			1,268	1,268	122			44,459
Waterford		1			20	20	2			701
Tehama County: Red Bluff		1			2,112	2,112	161			74,024
Trinity County:										
Big Bar	1	5	26	20	949	969	119			33,992
Coffee Creek	4	3	220	55	272	327	46			11,475
Hayfork	2	4	20	84	3,473	3,557	567			124,862
Helena	1	1	397	262	158	420	95			14,761
Junction City	3	8	44	8	10,252	10,260	1,018			359,758
Lewiston	6	5	2,502	309	7,308	7,617	1,129			267,325
New River	4	8	723	244	251	495	61			17,364
Salyer		8			378	378	38			13,255
Trinity Center	1	4	1	6	56	62	8			2,175
Weaverville	2	18	53	32	17,350	17,382	1,547			609,370

Tulare County:										
Bear Mountain	1	--	50	2	--	2	--	--	--	70
Porterville	1	--	10	3	--	3	2	--	--	106
White River	3	2	18	10	25	35	17	--	--	1,236
Tuolumne County:										
Columbia	33	7	12,549	3,648	343	3,991	1,688	1,000	--	140,874
East Belt [4]	7	1	26,741	3,395	103	3,498	820	--	--	122,960
Mother Lode [5]	16	13	58,932	6,489	10,436	16,925	4,521	1,000	--	595,396
Ventura County: Snowey	1	--	75	19	--	19	5	--	--	668
Yuba County:										
Bear River	--	1	--	--	252	252	16	--	--	8,830
Camptonville	1	4	100	20	591	611	59	--	--	21,423
Challenge	2	(6)	1,833	336	(6)	[9] 336	[9] 47	--	--	[9] 11,790
Dobbins	3	4	48	11	216	227	24	--	--	7,961
Smartville	--	3	--	--	11,750	11,750	949	--	--	411,863
Strawberry Valley	1	8	1,448	48	156	204	23	--	--	7,155
Combined districts [15]	21	20	505,753	46,849	67,802	114,651	107,068	1,202,800	69,100	4,203,056
Total California	927	676	4,648,249	738,616	572,513	1,311,129	2,590,804	1,612,000	990,000	47,767,894

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures.
[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: 2,541,016 fine ounces from lode mines and 49,788 fine 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] Included under "Combined districts."
[7] Not reported.
[8] Exclusive of lode output, which is included under "Combined districts."
[9] Exclusive of placer output, which is included under "Combined districts."
[10] Camanche district lies in Amador, Calaveras, and San Joaquin Counties.
[11] Chidago district lies in Inyo and Mono Counties.
[12] Randsburg district lies in Kern and San Bernardino Counties.
[13] Dale district lies in Riverside and San Bernardino Counties.
[14] Morongo district lies in Riverside and San Bernardino Counties.
[15] Includes following districts: Camanche in Amador County; Butte Creek (lode), Centerville, Forbestown (lode), and Stirling City (placer) in Butte County; Sherman and Slate Range in Inyo County; Kaiser Creek in Madera County; Hunter Valley (placer) in Mariposa County; Dog Creek and May Lundy in Mono County; Butcher Ranch (lode), Canada Hill, and Dutch Flat (lode) in Placer County; Genesee, Rich Bar (lode), and Wolf Creek (placer) in Plumas County; Dale (placer) in Riverside County; Monumental in San Bernardino County; Pine Valley in San Diego County; Centerville (lode), Iron Mountain, North Cow Creek, and Old Diggings, in Shasta County; Depot Hill, in Sierra County; Greenhorn (lode) in Siskiyou County; La Grange in Stanislaus County; and Browns Valley, Challenge (placer), and Yuba River in Yuba County.

AMADOR COUNTY

East Belt district.—The Wiljobar Corporation worked the Defender mine in the East Belt district during 1938. The Fort Ann mine was one of the larger producers of gold ore in the district. The A. E. Kent Dredging Co. operated a dragline dredge on South Sutter Creek near Volcano.

Ione district.—The Arroyo Seco Gold Dredging Co. dredged 2,212,565 cubic yards of gravel on Dry Creek 3 miles west of Ione and recovered 12,091 ounces of gold; the company operated one dredge equipped with eighty-six 6-cubic foot buckets throughout 1938 and another dredge with sixty-five 2½-cubic foot buckets during January and February. E. L. Lilly started operations with a dragline dredge October 7. The Humphreys Gold Corporation began operations with a dragline dredge January 28 and continued throughout the rest of the year; the company used three electrically powered dragline excavators and an electrically powered floating washer. The Rim Cam Gold Dredging Co. operated a dragline dredge on Dry Creek 6 miles north of Ione. The Horton mine near Buena Vista treated 30,000 cubic yards of gravel by hydraulicking and recovered 548 ounces of gold.

Mother Lode district.—The Argonaut Mining Co., Ltd., in the Mother Lode district near Jackson was on a production status in 1938 from January 1 to February 15 and from July 16 to the end of the year; an underground fire caused the suspension of output. Gold ore was treated by amalgamation in the company 300-ton ball mill and flotation plant, and the concentrates were shipped for smelting. The Central Eureka Mining Co. worked the Central Eureka and Old Eureka mines throughout 1938. According to the company printed annual report for the year ended December 31, 1938, 49,253 tons of gold ore, largely from the Old Eureka, were milled. During the early months of the year the company shipped its concentrates for cyanide treatment elsewhere, but after additions to its metallurgical plant the company treated its concentrates and current tailings by cyanidation and flotation. The Central Tailings Co., which had worked in part on the current tailings from the Central Eureka mine, went out of business. Gold production at the Fremont Gover depended largely on mine dumps during the early months of the year, but after July the ore treated came entirely from underground mining. The Kennedy Mining & Milling Co. operated its mill on ore during the early months of 1938; production from treatment of the company's old tailings in its 1,000-ton cyanide plant was continuous. The Keystone Mine Syndicate treated 11,944 tons of ore from its property 3 miles north of Martell; the ore yielded 1,178 ounces of gold by amalgamation and smelting of flotation concentrates. The Delta Tailings Co. continued to cyanide, in its 600-ton plant, material derived from a deposit of old tailings collected as a delta on one of the streams draining the Mother Lode district. The R. & M. Mining Co. handled approximately 124,000 cubic yards of gravel and recovered 699 ounces of gold by dragline dredging on Indian Creek. The Lincoln Gold Dredging Co., River Pine Mining Co., and Wolin-Hall & Wackman operated dragline dredges in the district.

BUTTE COUNTY

Butte Creek district.—The Humphreys Gold Corporation began operations on the Fitts property with a dry-land dredge November 6, 1938, and continued work until the end of the year. The McLain drift mine was operated throughout 1938.

Centerville district.—A stationary washing plant, to which gravel was delivered by power shovels and trucks, was used in 1938 to treat gravel from the Hintz mine; operations were carried on from August 23 to December 16.

Forbestown district.—The Idaho Maryland Mines Corporation suspended work at the Forbestown group of properties November 30, 1938, after several years of production and an intensive exploration campaign. During the year 5,157 feet of development headings were driven and 1,612 feet of diamond drilling done. Ore from the mine was treated in a 300-ton amalgamation and flotation plant; the concentrates were shipped to the company cyanide plant at Grass Valley.

Golden Summit district.—The Table Mountain Dredging Co. began operations on Thompson's Flat with a dragline dredge April 22, 1938.

Magalia district.—A nonfloating washing plant on the Coleman property, to which gravel was delivered by mechanical excavation, was the most productive operation in the Magalia district in 1938.

Oroville district.—The Oroville district continued in 1938 to be one of the leading sources of placer gold in California; dredges of both the connected-bucket and dragline types were large producers. The Butte Gold Dredging Co. sold its dragline dredge (1½-cubic-yard dragline excavator) in April to Lord & Bishop, who continued the operation throughout the rest of the year. Consuelo Mines terminated production by its two dragline dredges early in the year. The Gold Hill Dredging Co. launched an electrically powered connected-bucket dredge, equipped with seventy-four 9-cubic-foot buckets, on the Kister Ranch early in 1938 and produced steadily until the end of the year. The Penn Dredging Co. moved its dragline dredge from Honcut Creek in Butte County to Nevada County after producing during the first 3 months of 1938. The connected-bucket dredge of the Oroville Gold Dredging Co. was damaged severely by floods in Feather River but resumed production before the end of 1938. William Richter operated a large dragline dredge throughout the year on land adjoining Feather River. Cinco Mineros Co. operated a 1½-cubic-yard dragline excavator and floating washing plant in the district.

Yankee Hill district.—The Surcease mine treated 23,987 tons of gold ore by cyanidation and flotation in 1938 and recovered 4,911 ounces of gold and 8,982 ounces of silver; the concentrates were shipped for smelting.

CALAVERAS COUNTY [4]

Camanche district.—The Comanche Gold Dredging Co. operated its connected-bucket dredge during 1938 along Mokelumne River and dredged gravel in Amador, Calaveras, and San Joaquin Counties. Camanche Placers, Ltd., operated a dredge equipped with sixty-one 2½-cubic foot buckets at Camanche until May 23, when the work was suspended permanently. The Pacific Placers Engineering Co. oper-

[4] See also Julihn, C. E., and Horton, F. W., Mineral Industries Survey of the United States; California—Calaveras County, Mother Lode District (South): Bureau of Mines Bull. 413, 1938, 140 pp.

ated a dry-bank washing plant on the Cook property west of Valley Springs from February until the end of the year. Lessees operated a dragline dredge on the K. D. Winship Estate property in the Camanche district until June 8. The Lancha Plana Gold Dredging Co. operated its dredge with eighty-four 6-cubic foot buckets throughout 1938 on its properties along Mokelumne River. E. L. Lilly discontinued dragline dredging between Camanche and Wallace August 9, after working from the first of the year. The Wallace Dredging Co. operated an electrically powered connected-bucket dredge with sixty 3-cubic foot buckets in Calaveras and San Joaquin Counties along Bear Creek near Wallace.

Campo Seco district.—The Pacific Placers Engineering Co. operated a dry-bank washing plant on the Robbins claims from June to the end of 1938.

Copperopolis district.—The Jumbo Consolidated Mining Co. treated a substantial tonnage of gold ore from the Mt. King mine in the Madam Felix section of the Copperopolis district during 1938; the company increased the daily capacity of its flotation mill to 195 tons. The Western Empire Mines Co., Ltd., worked the Royal mine in the same section of the Copperopolis district; the ore was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter.

East Belt district.—The St. Joseph Lead Co. worked its Sheepranch mine from January 5 until the end of 1938, and the mine was by far the largest producer in the East Belt district. The S. O. S. Mining Co. closed the S. O. S. drift placer mine in October after recovering 58 ounces of gold from 2,200 cubic yards of gravel, mined by hoist and bucket.

Jenny Lind district.—The Milton Gold Dredging Enterprise operated its electrically powered dragline dredge on South Gulch near Milton throughout 1938. C. J. Thompson operated a small connected-bucket dredge with twenty-seven $1\frac{1}{10}$-cubic foot buckets during the year; the gravel was cemented so tightly that a dragline excavator was used to work ahead of the dredge to loosen the gravel so that the bucket line could dig it.

Mother Lode district.—A development campaign with some production was carried on throughout 1938 at the Big Springs mine in the Mother Lode district. The Carson Hill Gold Mining Corporation treated 379,618 tons of ore at its Carson Hill mill at Melones in 1938—the largest tonnage of ore treated at any single mill in California. Only one company tonnage in the State exceeded it—that of the Empire Star Mines Co., Ltd., in the Grass Valley-Nevada City district of Nevada County. The Carson Hill 1,100-ton mill treated the ore by amalgamation and concentration, followed by regrinding of the concentrates and their return to the pulp circuit for cyanidation, and recovered 24,650 ounces of gold and 6,653 ounces of silver. The Le Roi Mines, Inc., operated the Easy (Easyz) Bird mine in the Mokelumne Hill section of the Mother Lode throughout 1938; in addition to production of a substantial tonnage of ore, 1,500 feet of development drifts were driven as part of the company development campaign. The Mother Lode Central Mines, Inc., closed down its Marble Springs and Bullion Quartz claims April 16, after operating from the first of the year. The dragline dredging operation of the Triangle

Mining Co. southeast of San Andreas was taken over by the General Dredging Corporation November 8 and continued until the end of the year; equipment consisted of a floating washing plant and a dragline excavator with a 1¼-cubic yard bucket. A dragline dredge was operated from September 15 until the end of 1938 on Domingo Creek 3 miles north of Angels Camp. Another dragline dredge was operated from July 1 until September 10 on Chili Gulch. The San Andreas Dredging Co. worked a Diesel-powered dragline dredge in the San Andreas section of the Lode from August 20 until the end of 1938. The Universal Dredging Corporation operated a dragline excavator and a floating washer on Calaveras River from October 1 until the end of the year. The Vallecito Mining Co., Inc., operated the Vallecito Western drift mine on Six Mile Creek throughout 1938, mined 917 tons of gravel underground, and treated 27,223 cubic yards of old tailings.

ELDORADO COUNTY

East Belt district.—The Middle End mine in the East Belt district of Eldorado County was operated in 1938 by Cosumnes Mines, Inc.; 950 tons of gold ore yielded 124 ounces of gold by amalgamation and 430 ounces of gold from the smelting of flotation concentrates.

Mother Lode district.—The Beebe Gold Mining Co. continued its operation of the Beebe mine in the Georgetown section of the Mother Lode throughout 1938 but suspended work at the Alpine mine before the end of the year; the ore was treated by flotation, and the concentrates were cyanided. Ore from the Black Oak mine, operated by R. J. Wilson throughout 1938, was treated by amalgamation and flotation, and the resulting concentrates were shipped to a smelter. The Kelsey Mining Co., Inc., conducted an exploration program at the Kelsey mine until July 1, when the Kelsey Mining Corporation took over the property; gold ore was produced throughout the year. The Lode Development Co. worked the Rozecrans mine in the Garden Valley section of the Lode throughout 1938 and recovered a substantial output of gold from the treatment of gold ore by amalgamation, flotation, and smelting of concentrates. The Middle Fork Gold Mining Co. worked the Sliger mine intermittently. The Horse Shoe Dredging Co. operated a dragline dredge on Buck's Bar on the North Fork of Cosumnes River from October 15 until the end of 1938.

West Belt district.—The Big Canyon mine in the Shingle Springs area of the West Belt district—the largest mining operation in Eldorado County—was worked by The Mountain Copper Co., Ltd., throughout 1938; the ore was treated by flotation, and the resulting concentrates were shipped to a smelter. Big Canyon Dredge (a dragline outfit) treated 760,000 cubic yards of gravel in Big Canyon Creek and recovered 3,476 ounces of gold. The Crystal mine 3 miles south of Shingle Springs was taken over by a new management in February 1938, and on October 5 the operating company was incorporated as the El Dorado Crystal Mine. During the early months of the year, a 100- to 125-ton all-slime, countercurrent decantation cyanide mill was built; milling of dump ore was begun July 12, but from September on the mill feed was entirely newly mined ore. Offices, a change house, an assay plant, and other structures were erected at the property, in addition to the mill.

FRESNO COUNTY

Friant district.—There were a number of small lode and placer operations in the Friant district in 1938. The largest production was made by the Grant Service Rock Co., Cons., which produced gold as a byproduct of its sand and gravel business.

HUMBOLDT COUNTY

Orleans district.—Hydraulicking at the Pearch mine made it the largest gold producer in Humboldt County in 1938.

IMPERIAL COUNTY

Cargo Muchacho district.—O'Brien Mines, Inc., which succeeded Socorro Mines, Inc., April 1, 1938, as operator of the American Girl mine, produced 54,155 tons of gold ore. The ore was treated in the company 160-ton flotation mill, and the resulting 1,192 tons of copper concentrate shipped for smelting contained 7,773 ounces of gold, 3,054 ounces of silver, and 73,588 pounds of copper. In addition to operating a custom cyanide mill near Andrade in 1938 Holmes & Nicholson Mining & Milling Co. operated the Cargo Muchacho group of claims in the nearby Cargo Muchacho district. The Sovereign Development Co. conducted a development campaign at the Sovereign mine throughout 1938 and produced some ore, which was treated by cyanidation. Small quantities of gold and silver were recovered from the cyanide leaching of the Tumco old tailings.

INYO COUNTY

Cerro Gordo district.—The Morning Star Keeler Lease treated 2,500 tons of ore and 800 tons of old tailings from the Morning Star mine between April 5 and October 15, 1938, recovering 595 ounces of gold and 6,357 ounces of silver by cyanidation. The Santa Rosa mine shipped a small quantity of lead ore rich in silver. Keeler Gold Mines, Inc., treated a small tonnage of old tailings from the Trovine mine.

Chidago district.—The Cardinal Gold Mining Co., one of the ten leading lode gold producers in California during 1937, ceased operations August 29, 1938, owing to exhaustion of known ore bodies. In 1938, until that date, 36,468 tons of ore were treated by flotation and 1,397 tons of concentrates shipped to a smelter; the concentrates contained 8,580 ounces of gold, 2,485 ounces of silver, and 70,323 pounds of copper.

Coso district.—A number of small operators were reported working ore and old tailings in the Coso district during 1938.

Darwin district.—The Darwin Lead Co. shipped a small quantity of argentiferous lead ore from the Defiance mine in 1938.

Echo Canyon district.—The Inyo Consolidated Mines, Inc., which operated the Inyo mine during 1938, treated 1,500 tons of ore by amalgamation and recovered 309 ounces of gold.

Mt. Argus district.—Ore mined at the Oneida property in 1938 was treated by cyanidation after being crushed to ¼-inch mesh; 432 ounces of gold were recovered from 2,453 tons of ore.

Sherman district.—The Argus Mining Co., organized in February 1938, operated the Arondo mines under a lease and purchase agreement.

Slate Range district.—The Gold Bottom Mines, Inc., worked the Copper Queen group of claims throughout 1938; the ore mined was treated in the company 25-ton flotation mill, and the resulting concentrate was shipped for smelting.

South Park district.—Burton Bros., Inc., worked the Ruth mine throughout 1938.

Union district.—A substantial tonnage of gold ore from the Reward mine, also known as the Brown Monster, was shipped during 1938.

Wild Rose district.—The Silver Ball and Skidoo mines were the leading producers in the Wild Rose district in 1938.

KERN COUNTY

Cove district.—The Kern Mines, Inc., treated 36,410 tons of ore from the Big Blue mine by flotation during 1938 and shipped the concentrates—containing 4,934 ounces of gold and 4,901 ounces of silver—to a smelter. During the year 1,198 feet of development headings were driven.

Green Mountain district.—The Piute Mining Co. operated the Skyline mine in 1938.

Mojave district.—The Cactus Mines Co., which operated the Cactus Queen mine in the Middle Butte section of the Mojave district, was the leading silver producer in California during 1938 and one of the larger gold producers as well, despite the fact that this mine was only a prospect 2 or 3 years ago. The first dividend—$184,000—was paid during 1938. The gold-silver ore produced was treated by cyanidation and flotation, and the resulting concentrates were shipped for smelting. The Eureka Lease reported the production of 6,375 tons of gold ore in 1938 and its shipment to a custom cyanide plant for the recovery of 2,293 ounces of gold and 5,151 ounces of silver. The Fairview mine in the Rosamond section of the Mojave district was operated throughout 1938. The Golden Queen Mining Co., the largest producer in the Mojave district in 1938, operated on gold ore throughout the year. In addition to the company output of ore, an almost equal quantity of custom ore was treated at its 450-ton cyanide plant. During 1938, 13,003 feet of development headings were driven at the property. The Karma mine, one of the old properties of the district, yielded a small quantity of gold-silver ore. A substantial tonnage of ore was shipped from the Middle Butte property. The Lodestar Mining Co., one of the leading producers in the district, shipped gold-silver ore for treatment at the Golden Queen custom mill. Burton Bros., Inc., worked the Tropico mine throughout 1938 and in addition to treating ore from its own property conducted a large custom mill business; the company policy of accepting very small shipments of custom ore has been a major factor in the development of the Mojave and nearby mining districts. Development work by Whitmore Mines, Inc., and by lessees on the Whitmore property resulted in the production of a small quantity of ore. Lessees worked the Yellow Dog mine.

Randsburg district.—In 1938 the Butte Lode Mining Co. treated 2,846 tons of ore and recovered 830 ounces of gold and 239 ounces of silver by amalgamation. Small tonnages of ore and old tailings were treated at the King Solomon property. A considerable tonnage of low-grade ore from the Operator mine was handled by the Operator

Consolidated Mines Co. The Anglo American Mining Corporation, Ltd., which operated the Yellow Aster mine, was the leading producer in the Randsburg district. Material produced from the company open pit was treated by stage crushing and screening to eliminate the larger part of the bulk as waste; the undersize was ground and amalgamated, and the tailings were sent to the company cyanide plant where they were treated along with large quantities of old tailings. In all, 189,979 tons of ore and 374,694 tons of old tailings were handled to recover 14,012 ounces of gold and 4,062 ounces of silver.

LOS ANGELES COUNTY

The Western Graphite Co. flotation mill at Lake Hughes, which had treated custom ore for several years, suspended operation during 1938; the mill was dismantled.

Cedar district.—The Governor Mine Co., the largest mine in the Cedar district in 1938, treated a substantial tonnage of ore and old tailings from the Governor mine by amalgamation.

Neenach district.—A small quantity of ore was shipped during 1938 from the Valvue mine for treatment at custom flotation and cyanide mills.

MADERA COUNTY

A number of small lode and placer mines were active in the Hildreth and Potter Ridge districts during 1938.

MARIPOSA COUNTY

Colorado district.—Lessees operated the Schroeder group from February 16 until the end of 1938 and produced 329 tons of ore, from which 469 ounces of gold and 61 ounces of silver were recovered by amalgamation.

Hunter Valley district.—The Cotton Creek Mining Co. treated 2,037 tons of gold ore between May 1 and the end of 1938 and recovered 459 ounces of gold and 219 ounces of silver; the company built a 35-ton amalgamation and flotation mill during the year. The Mt. Gaines Mining Co. produced a substantial tonnage of gold ore. Cyanidation of 3,015 tons of old tailings at the Ruth Pierce mine yielded 153 ounces of gold and 126 ounces of silver; a 72-hour leaching period was used at the 15-ton cyanide leaching plant.

Mother Lode district.—The Bandarita Mining Co. treated 3,251 tons of ore from its property in the Mother Lode district by amalgamation and flotation during 1938 and recovered 401 ounces of gold and 322 ounces of silver. The Bondurant Mining & Milling Co. and the Carda Mining Co. (Champion mine) were active. The Boston California Mining Co. installed a 100-ton flotation mill at the Malvina mine and treated a substantial quantity of ore before the end of 1938. Operation of the Miocene No. 2 and Goldbug claims in the Coulterville section of the Lode yielded 145 tons of ore, from which 559 ounces of gold and 120 ounces of silver were extracted by amalgamation. The Pacific Mining Co., which operated the Pine Tree and Josephine mines, continued to be the leading producer of gold in Mariposa County; the company operated its 150-ton flotation mill throughout the year. The Trebor Corporation began operations with a floating washing plant fed by a 1¾-cubic yard dragline excavator on Mariposa Creek

September 8. The Nutting Dredging Co. also operated a dragline dredge in the district. The Placer Properties Co., Inc., operate a dragline dredge using a dragline excavator on Mariposa Creek throughout 1938.

Whitlock district.—The Diltz mine was the leading producer in the Whitlock district during 1938. M. T. Tresidder, a lessee on the Miner's Hope mine, treated 1,327 tons of ore and recovered 269 ounces of gold and 79 ounces of silver before his lease terminated September 22. The Our Chance Mining Co. transferred the Our Chance mine to A. E. Clark January 1; 271 tons of ore produced at the property during 1938 yielded 182 ounces of gold and 28 ounces of silver.

MERCED COUNTY

Snelling district.—The connected-bucket dredges in the Snelling district produced virtually all the gold output of Merced County in 1938. The Merced Dredging Co. operated one electrically powered dredge with sixty 9½-cubic-foot buckets throughout the year. The San Joaquin Mining Co. dredged gravel 1½ miles west of Snelling; its boat was equipped with sixty-four 9½-cubic-foot buckets. The Snelling Gold Dredging Co. had two electrically powered connected-bucket dredges in operation throughout 1938; one had sixty-six 7-cubic-foot buckets and the other seventy-two 7-cubic-foot buckets. Yuba Consolidated Gold Fields, the largest producer in the district, worked two dredges of the connected-bucket type, one equipped with seventy-two 9-cubic-foot buckets and the other with seventy-one 5¾-cubic-foot buckets.

MODOC COUNTY

High Grade district.—Modrell Bros. prospected the Trinity and Trinity Extension properties and produced a small quantity of gold as a result of test runs during 1938.

MONO COUNTY

Bodie district.—The Roseklip Mines Co., which worked old dumps on the group of claims formerly operated by the Standard Consolidated Mining Corporation, was the largest producer of gold in Mono County in 1938; the ore was treated in a 300-ton cyanide plant. No underground development work was done on the property.

Masonic district.—A small quantity of gold ore was treated at the Chemung mine in 1938.

May Lundy district.—The Log Cabin mine was worked in 1938 by the Mutual Gold Corporation from the first of the year until April 20.

Mount Patterson district.—Sierra Consolidated Mines, Inc., suspended operations at the Silverado-Kentuck mines during 1938, owing to exhaustion of ore; a large quantity of silver ore was mined and treated by flotation in 1938 before the property was closed down. In 1937 this property was the leading silver producer in California.

NAPA COUNTY

Calistoga district.—The Graham Loftus Oil Corporation took over the Grigsby (Palisade) mine from the Coast Range Mining Corporation during 1938. Production of gold-silver ore and its treatment by flotation were continued; concentrates were shipped for smelting.

NEVADA COUNTY

Grass Valley-Nevada City district.—Gold production from the lode mines of the Grass Valley-Nevada City district in 1938 made it again the leading metal-producing district in California and among the largest in value of metal production in the United States. Operation of the Grass Valley Bullion Mines, Inc., property continued under the company working agreement with the Idaho Maryland Mines Corporation; all the ore produced was treated at the Idaho Maryland plant. During the year a reversal of the court decision with respect to extralateral rights was a severe blow to the latter company, but early in 1939 negotiations were reported under way to settle the dispute without further litigation. The Daisy Blue Mine, Inc., worked its property from September 14 to December 3. The Empire Star Mines Co., Ltd., continued operations at its mines in Nevada and Yuba Counties. In the Grass Valley section of the Grass Valley-Nevada City district, the Empire, North Star, and Pennsylvania mines formed one of the most productive operating units in the State; in the Nevada City section of the district, the company worked the Murchie mine. In addition, the company operated the Zeibright property on Bear River near Emigrant Gap and the Pennsylvania mine at Browns Valley in Yuba County. The Newmont Mining Corporation was a very large holder of stock in these enterprises. The Golden Center mine was operated throughout the year by Cooley Butler. The Great Northern Gold Mines, Inc., worked its property 3½ miles northeast of Nevada City throughout 1938 and treated 3,000 tons of ore in its flotation mill to recover 60 tons of concentrates containing 820 ounces of gold; the company did 500 feet of development work. In 1938 the Idaho Maryland mine, operated by the Idaho Maryland Mines Corporation, attained the distinction of being the most productive single mining operation in California. According to the company annual report for the year ended December 31, 1938, 331,406 tons of ore were stoped and more than 400,000 tons of ore developed; the company paid $1,063,406.30 in dividends during 1938, bringing its total dividends to date to $3,584,429. A decision for the company in the United States Circuit Court of Appeals for the Ninth District, which held that the company was not engaged in interstate commerce and hence did not operate under the provisions of the Wagner Act, was of great importance in clarifying labor relations at gold mines in California. The Lava Cap Gold Mining Corporation operated throughout 1938 and treated 108,720 tons of ore by amalgamation and flotation to recover 30,321 ounces of gold and 301,008 ounces of silver. Not only was this company one of the leading gold producers of the State, but its silver production was one of the largest in California; 16,700 feet of development work were done during the year. The Campbell Grass Valley Mining Co. mined 5,444 tons of gold ore at the Norambagua mine 5 miles south of Grass Valley; 2,183 ounces of gold and 454 ounces of silver were produced. Late in 1938 the mill was shut down, and underground work was diverted to exploration and development. The Atlas Gold Dredging Corporation operated a washing plant and a dragline excavator with two 2½-cubic-yard buckets on Deer Creek. The Gold Star Dredging Co. began dragline dredge operations on the Douglas property on Deer Creek 2 miles west of Rough and Ready September 28; the equipment consisted of a

1-cubic-yard all-steel washing plant and a dragline excavator with a 1-cubic-yard bucket. The Dakins Co. began dragline dredging on the Gilham and Yue claims on Wolf Creek in October and continued until the end of 1938. On May 16 the dragline dredge equipped with a 3-cubic-yard dragline excavator, moved by the Innis Dredging Co. from the Oroville district in Butte County, began operations on Deer Creek that were continued until the end of 1938. This company took over management of the Deer Creek Placer Mining Co., which had operated its dragline dredge on the property during the early months of the year.

Washington district.—The Bradley Mining Co., largest producer in the Washington district in 1938, operated the Spanish mine throughout the year; 22,990 tons of ore were treated by cyanidation and flotation to yield bullion, containing 976 ounces of gold and 6,477 ounces of silver, and concentrates, containing 3,566 ounces of gold, 38,687 ounces of silver, 234,440 pounds of lead, and 114,963 pounds of copper. The Shovel Placer Mining Co. treated a large quantity of gravel at a stationary washing plant to which the gravel was delivered by the use of power shovels and trucks. Omega Mine, Inc., lessees from the South Yuba Mining & Development Co., operated the Omega mine by hydraulicking.

You Bet district.—A dry-land dredge using a ⅞-cubic-yard dragline excavator worked the Shorty Jefferies claim during 1938, handled 5,000 cubic yards of gravel, and produced 144 ounces of gold.

PLACER COUNTY

Auburn district.—Operation of the Gaylord drift mine in 1938 yielded 344 ounces of gold. In addition, numerous lode and placer mines were operated in the Auburn district.

Butcher Ranch district.—The Monarch Mining Co. worked the Monarch mine from January 15 to June 2, 1938; a 100-ton countercurrent decantation cyanide plant was used.

Dutch Flat district.—The Canyon Mines Corporation operated the Rawhide group 5 miles east of Towle throughout 1938.

Iowa Hill district.—The Campbell Gold Mines, Ltd., mined 1,057 cubic yards of gravel from the Campbell drift mine during 1938 and shipped 160 ounces of gold. The McGeachin Mining Co. and lessees on the Jupiter, Big Dipper, Hazelrath, Weber, Schwab, and Winchester claims in Shirttail Canyon produced 164 ounces of gold by drift mining.

Lincoln district.—Pantle Bros. operated a portable washing plant, to which gravel was delivered by a dragline excavator with a 1-cubic-yard bucket, at Auburn Ravine placers during 1938; 500,000 cubic yards of gravel were treated and 1,808 ounces of gold recovered. F. O. Bohnett also operated a nonfloating outfit. The Fay Placer mine 2 miles east of Lincoln was worked by a dragline dredge using a dragline excavator from March 9 until the end of the year; in addition to the gold produced, the gravels yielded a considerable quantity of zircon sand. The Lincoln Gold Dredging Co. worked its dragline dredge near Lincoln. Jasper-Stacey Co. worked its property 4 miles east of Lincoln throughout 1938 by dragline dredging, using a 2-cubic-yard electrically powered dragline excavator.

Ophir district.—The Alabama California Gold Mines Co. worked the Alabama mine throughout 1938. The Auburn-Chicago Mining Co., which had operated the Chicago, Elizabeth, and Mary Len claims for several years, discontinued operations November 25. The Oro Fino Consolidated Mines worked the Oro Fino mine; the company ore was treated in a 300-ton amalgamation and flotation plant erected during the year, and the concentrates were shipped to the Idaho Maryland custom cyanide plant. The Burm-Ball Mining Co. operated the Sisley mine throughout 1938. The Three Star Mining Co. unwatered the Three Star mine in 1938 and produced a small quantity of gold ore before the end of the year. The Gold Hill Dredging Co. operated a dredge of the connected-bucket type, equipped with eighty-seven 8½-cubic-foot buckets, on the Barton Ranch and Chabot property throughout the year. The General Utility Corporation operated a dragline dredge with a 1¼-cubic yard excavator from the first of the year until March 3, on a property 3 miles southeast of Roseville. The Panob Gold Dredging Co. operated a nonfloating washing plant to which gravel was delivered by a dragline excavator with a 1¼-cubic-yard bucket from August 5 until December 22. The Antelope Gold Dredging Co. operated a dredge of the connected-bucket type, with thirty-eight 3-cubic-foot buckets, on Antelope Creek from the first of the year until November 25. The Oro Bell Dredging Co. handled 239,700 cubic yards of gravel in its connected-bucket dredge, equipped with seventy-two 4½-cubic-foot buckets, in 1938; 1,360 ounces of gold were recovered.

PLUMAS COUNTY

Crescent Mills district.—The North Canyon Mines, Inc., produced 20,020 tons of gold ore in 1938 from the Droege and New York mines, which yielded 3,251 ounces of gold; the ore was treated in the company 70-ton amalgamation and flotation mill. The Indian Valley Mining Co., Inc., worked the Standart mine throughout the year and built a 125-ton amalgamation-flotation mill to replace the 10-stamp mill formerly used at the property. The Glacier drift mine yielded 365 ounces of gold from 2,881 tons of gravel as a result of intermittent operations during 1938.

Genesee district.—The Walker mine (operated by the Walker Mining Co., an affiliate of the Anaconda Copper Mining Co.), the outstanding mine in Plumas County for many years, dropped to second place in value of production during 1938 owing to decreased output. The property was on a curtailed basis from January 1 to May 31, on a shut-down basis from June 1 to October 31, and on an operating basis from November 1 to December 31. According to the company printed annual report for the year ended December 31, 1938:

> 75,160 wet tons of ore were broken, 66,822 dry tons of ore were milled, and 2,516 dry tons of concentrates produced in the company's 1,800-ton flotation plant. Net recoverable metal content of the 2,463 dry tons of concentrates and lime scale shipped was: Copper, 1,188,271 pounds; silver, 44,273 ounces; and gold, 2,029 ounces.

Rich Bar district.—The Virgilia Mining Corporation operated the Ohio Point quartz claim throughout 1938, and the value of its product was the largest in Plumas County; the ore was treated in the company

250-ton flotation mill, and the resulting concentrates were shipped for smelting. Lord & Bishop operated a dragline dredge with a 1½-cubic-yard excavator at Grays Flat from August 1 until the end of the year and produced 741 ounces of gold.

RIVERSIDE COUNTY

Chuckawalla district.—The output at the Red Cloud lode property was the largest in the Chuckawalla district in 1938.

Dale district.—A number of small lode operations in 1938 were reported in the Riverside County part of the Dale district, but the principal producer of the district was across the line in San Bernardino County.

Eagle Mountain district.—The Imperial Smelting & Refining Co. worked the Black Eagle mine intermittently during 1938 and treated 2,025 tons of ore and 4,375 tons of old tailings in its 75-ton concentration mill to produce 247 tons of lead-copper concentrates; the concentrates contained 342 ounces of gold, 4,610 ounces of silver, 242,246 pounds of lead, and 18,616 pounds of copper.

Pinacate district.—The Ida Leona Mine & Milling Co. worked the Ida Leona mine throughout 1938. During the year the shaft was sunk from the 100- to the 200-foot level and some new machinery was installed on the surface; 1,297 tons of gold ore were treated to yield 868 ounces of gold and 254 ounces of silver.

SACRAMENTO COUNTY

Cosumnes River district.—The Cosumnes Gold Dredging Co. operated a sixty-three 12-cubic-foot connected-bucket dredge throughout 1938 and handled 3,411,337 cubic yards of gravel, which yielded 11,018 ounces of gold. Lord & Bishop operated a dragline dredge from January 1 to July 7 and recovered 2,064 ounces of gold from 247,500 cubic yards of gravel.

Folsom district.—The Capital Dredging Co. operated three connected-bucket dredges throughout 1938 in the Folsom district; one had sixty-two 8½-cubic-foot buckets, another eighty-eight 18-cubic-foot buckets, and a third one hundred 18-cubic-foot buckets. The General Utility Corporation operated a washing plant and a 1½-cubic-yard dragline excavator until October 3; on October 27 the General Dredging Corporation took over the operation and continued it until the end of the year. The Gold Hill Dredging Co. produced a considerable quantity of gold from the clean-up of a dredge formerly operated in the Folsom district but moved during 1938 to the Ophir district in Placer County. The Natomas Co., the largest operator in Sacramento County, was working a fleet of seven electrically operated connected-bucket dredges in the Folsom district at the end of 1938. The number and size of buckets per dredge were: No. 1 dredge, sixty-two 16-cubic-foot buckets; No. 4, sixty-seven 15-cubic-foot buckets; No. 5, one hundred and five 12-cubic-foot buckets; No. 6, one hundred and six 11-cubic-foot buckets; No. 7, ninety-eight 9-cubic-foot buckets; No. 8, one hundred and five 12-cubic-foot buckets; and No. 10, eighty-three 15-cubic-foot buckets. The Hoosier Gulch Placers operated a dragline dredge 5 miles southeast of Sloughhouse throughout the year.

SAN BERNARDINO COUNTY

Buckeye district.—The Bagdad Chase Extension Mining Syndicate conducted an extensive exploration campaign on the Butte Hill group and Roosevelt mine during 1938.

Calico district.—Most of the production from the Calico district in 1938 came from cyanidation of old tailings at the Old Barber, Silver King, Waterloo, and Zenda properties.

Dale district.—The Carlyle Mining Co. worked the Carlyle mine during 1938. The Gold Crown Mining Co., Ltd., largest producer in San Bernardino County in 1938, worked the Gold Crown group; during the year the company 50-ton cyanide plant was moved 6 miles from its former location in Riverside County into San Bernardino County.

Halloran Springs district.—Operation of the Lucky mine by E. Johnson and lessees in 1938 yielded 957 tons of gold ore, the larger part of which was shipped for smelting.

Holcomb Valley district.—The Holcomb Valley Placer Co. treated 8,000 cubic yards of gravel in 1938 to recover 103 ounces of gold between May 1 and December 20. The company operated a nonfloating washing plant of the centrifugal bowl type, to which gravel was delivered by power shovel.

Ivanpah district.—The Colosseum Mining & Smelting Corporation worked the Colosseum mine during 1938.

Old Woman Mountain district.—Ore and old tailings were treated by amalgamation and concentration at the Valley View property in 1938. The Vulcan mine was active, and the ore mined was treated in an amalgamation-gravity concentration mill.

Randsburg district.—A large tonnage of gold-silver ore was shipped from the Kelly mine in 1938 for smelting.

SAN FRANCISCO COUNTY

Almost 100 ounces of gold were credited to San Francisco County in 1938 in consequence of production by small-scale placer miners working the public Pacific Ocean beach sands near the San Mateo County line.

SAN JOAQUIN COUNTY

Linden district.—A. G. Watkins & Sons operated a dragline dredge in the Linden district for a short period during 1938.

Wallace district.—The Wallace Dredging Co., which operated principally in Calaveras County in 1938, treated a small quantity of gravel when it worked for a short period across the line in San Joaquin County. Another operation on the county line, that on the K. D. Winship Estate property, recovered a substantial quantity of gold by dragline dredging in San Joaquin County.

SAN LUIS OBISPO COUNTY

Oro Fino district.—F. H. Gates, Inc., recovered 215 ounces of gold between January 1 and May 26, 1938, as a byproduct of cleaning sand and gravel for highway construction. The auriferous gravel was mined on Oro Fino Canyon, a tributary of San Antonio River.

SHASTA COUNTY

French Gulch district.—Ore from the Miners Group of mines, active from September until the end of the year, was treated in a 25-ton flotation mill installed during 1938. The J. H. Scott Co. worked the Washington mine, treated 2,901 tons of ore by amalgamation and flotation, shipped 30 tons of ore for direct smelting, and recovered, in all, 1,633 ounces of gold and 422 ounces of silver. A plant, having a 50-ton rod mill, pulsating jigs, and flotation equipment, was constructed during 1938 by the company.

Igo district.—The area southwest of Redding, which includes the towns of Igo, Ono, Gas Point, and Cottonwood, was the scene of numerous placer operations in 1938, most of which employed dragline dredges. Cinco Mineros operated a dragline dredge using a 1½-cubic yard excavator during the last 3 months of the year. Carlson & Sandburg operated two dragline dredges during part of the year. The Pioneer Dredging Co. worked two dragline dredges on Dry Creek throughout 1938; one of the outfits was powered entirely by electricity and handled 1,356,870 cubic yards of gravel. The El Oro Dredging Co. operated a dragline excavator equipped with a 1½-cubic yard bucket. R. S. Olson operated a dragline dredge from April until the end of the year. A dragline dredge of the Pilot Dredging Co. worked intermittently on a placer property 6 miles south of Redding. Piombo Bros. & Co. operated a dragline dredge and a 1½-cubic yard bucket on Clear Creek intermittently from July 1 until the end of 1938. The Red Hill property on Olney Creek was worked with a dry-land dredge using a dragline excavator from October 3 until the end of the year. The Roaring River Gold Dredging Co. operated the only dredge of the connected-bucket type in Shasta County on its property on Roaring River; the dredge carried seventy-two 3-cubic foot buckets. During the early months of 1938 the Gold Acres Dredging Co. operated a dragline dredge, equipped with jigs, on the Thibaut Ranch.

Iron Mountain district.—The Mountain Copper Co., Ltd., largest mining operation in Shasta County, worked its Iron Mountain property throughout 1938. All the material mined was treated by cyanidation, one-third going to the countercurrent decantation plant and two-thirds to the sand-leaching plant.

Old Diggings district.—During February 1938 the Star Gulch Mining Co. turned over management of the Walker mine to the Stewart-Brown Co., which operated the property until October 10. Fourells Dredging Co. worked a section of Churn Creek 4 miles east of Redding from April 26 to May 25 by dragline dredging.

Redding district.—Larson Bros. constructed an 18- to 24-ton amalgamation plant on the Blue Gravel mine and treated a considerable tonnage of ore during 1938.

SIERRA COUNTY

Alleghany district.—Gamble & Wilson operated the Kenton mine throughout 1938 and treated a considerable tonnage of ore by amalgamation and cyanidation in its 30-ton 10-stamp mill. Original Sixteen to One Mine, Inc., leading producer in Sierra County, worked the Sixteen to One and Tightner mines throughout the year;

development work done totaled 2,300 feet. On April 1, O'Brien Mines, Inc., succeeded Socorro Mines, Inc., as operator of the Plumbago mine. During the year 9,753 tons of ore were treated by amalgamation and cyanidation and yielded 2,995 ounces of gold as bullion and 663 ounces by the smelting of concentrates. Development work included 557 feet of drifting, 593 feet of raising, 103 feet of sinking, and 881 feet of diamond drilling. The Kanaka Corporation abandoned its operations with a dragline dredge on Kanaka Creek 3 miles below Alleghany after working from April through July. The Lone Wolf and Gold Band claims yielded 195 ounces of gold from 7,000 cubic yards of gravel treated by hydraulicking. The Ruby mine 3½ miles southeast of Goodyears Bar was operated as a drift mine during 1938.

Depot Hill district.—The Depot Hill mine was worked by hydraulicking from the first of 1938 until July 14.

Downieville district.—The Tombstone Development Co. treated 5,000 tons of gold ore at the Bigelow mill during operations in 1938 that lasted from June until the end of the year; 815 ounces of gold and 412 ounces of silver were recovered. The Golden Bear Mines, Ltd., worked the Golden Bear drift mine.

SISKIYOU COUNTY

Callahan district.—The connected-bucket dredge operated by Yuba Consolidated Gold Fields on Scott River near Callahan was the leading gold producer in the Callahan district in 1938; the dredge was equipped with seventy-two 9-cubic foot buckets.

Greenhorn district.—The Cal Oro Dredging Co. operated a dredge of the connected-bucket type from January 12 until the end of 1938 on the Tebbe property west of Yreka. A connected-bucket dredge with sixty-seven 6-cubic foot buckets, operated by the Yreka Gold Dredging Co., produced 10,957 ounces of gold and 1,522 ounces of silver from 1,558,069 cubic yards of gravel mined on ground 2 miles north of Yreka; this operation was the leading gold producer in Siskiyou County.

Klamath River district.—Klamath River has cut a deep channel many miles long through the gold-bearing mountains of Siskiyou County; many mines, most of them placers, are situated along its course. The majority of these operations are conducted on a very small scale and employ only hand methods. The St. Lawrence Mining Co., however, treated 90,000 cubic yards of gravel from the Reeves property in 1938 and recovered 812 ounces of gold by use of a stationary washing plant, to which gravel was delivered by carry-alls drawn by tractors. Drift-mining operations were reported at the Hoosier Hill placer on Klamath River. The Kookaburra Mines, Inc., operated a nonfloating washing plant to which gravel was delivered by high-line cableway using a ¾-cubic yard bucket. William von der Hellen Mines treated 32,000 cubic yards of gravel from McConnell Bar and recovered 517 ounces of gold between June 10 and August 21; this company used a stationary washing plant to which gravel was delivered by trucks loaded by a 1¼-cubic yard power shovel. Harms Bros. and Larsen Bros. began operations on Horse Creek on the Scandia mine December 1, 1938, and continued until the end of the year; a dragline dredge was used.

Liberty district.—The Gold Ball Mining Co. operated the Gold Ball mine during 1938. The King Solomon Mines Co., leading lode-mine operator in Siskiyou County, worked the King Solomon mine as an open-cut. George Tulare produced 230 ounces of gold by hydraulicking 8,000 cubic yards of gravel at the Joubert mine 2 miles from Sawyers Bar. The S. T. S. mine on Eddy's Gulch was the largest hydraulic operation in the Liberty district.

Salmon River district.—Lessees produced 108 ounces of gold from 105 tons of ore mined in 1938 at the Ida May and Francis Bell claims between June 8 and the end of the year. Hydraulic and small-scale hand methods contributed a substantial output of placer gold in the Salmon River district.

Scott River district.—The Frederica lode claim was active throughout 1938. Hydraulicking was carried on at the Roxbury property.

STANISLAUS COUNTY

Knights Ferry district.—Carlson & Sandburg operated two dragline dredges in the vicinity of Wildcat Creek during 1938. On the Robuck property a washing plant, to which gravel was delivered by a dragline excavator, handled 10,000 yards of gravel during intermittent operations from October until the end of the year; 122 ounces of gold were recovered.

La Grange district.—The La Grange Gold Dredging Co., which operated a connected-bucket dredge throughout 1938, was the leading gold producer in Stanislaus County. The Tuolumne Gold Dredging Corporation began operations June 15 with a dredge of the connected-bucket type with one hundred and one 12-cubic foot buckets and continued until the end of the year.

TEHAMA COUNTY

Red Bluff district.—The Midland Co. began operations with a dragline dredge on Sacramento River February 20, 1938, and continued to the end of the year.

TRINITY COUNTY

Big Bar district.—A stationary washing plant to which gravel was delivered by a ¾-cubic yard dragline excavator was operated on the Pattison Ranch from January 15 to August 29, 1938.

Hayfork district.—The Hayfork Gold Dredging Co. operated a 1¼-cubic yard dragline excavator and floating washing plant near Hayfork during 1938.

Helena district.—In 1938 Al Hansen & Co. produced at the Enterprise mine 397 tons of ore, which was treated by amalgamation and flotation to recover 262 ounces of gold and 78 ounces of silver.

Junction City district.—Lessees on the Bergin mine hydraulicked 75,000 cubic yards of gravel in 1938 to recover 230 ounces of gold before their leases expired October 1. The property of Canyon Placers, Inc., was worked as a hydraulic mine from January 1 to June 10. The Junction City Mining Co. operated a connected-bucket dredge on Trinity River 1 mile above Junction City throughout the year. Lessees on the Red Hill mine hydraulicked a large quantity of gravel between the first of the year and July 1. The Golden Gravels

Mining Co. worked the Sourdough property with a 2-cubic yard dragline excavator and floating washing plant.

Lewiston district.—The Brown Bear Mines Corporation worked the Brown Bear mine during 1938. The dragline dredge operation on the Lowden Ranch was taken over by Interstate Mines, Inc., and was active from August until the end of the year; a 3-cubic yard excavator and 2½-cubic yard bucket were employed. On Trinity River near Lewiston the Lewiston Gold Dredging Co. operated a connected-bucket dredge with forty-six 8- and 9-cubic foot buckets throughout the year. The Trinity Dredge Co., after operating its connected-bucket dredge equipped with forty-two 11-cubic foot buckets from the first of the year until the end of October, leased it to T. D. and C. R. Harris, who continued the operation until the end of the year.

Salyer district.—Hydraulicking was carried on by the Swanson Mining Corporation on Trinity River and its South Fork from June 1 to 15, 1938.

Weaverville district.—Carlson & Sandburg continued their dragline dredge operation on Indian Creek near Douglas City during 1938. The General Utility Corporation operated a dragline dredge from November 1 until the end of the year; the equipment included a dragline excavator with one 1¼-cubic yard bucket. The Oro Trinity Dredging Co. worked a dragline dredge equipped with a 1½-cubic yard dragline. The Pioneer Dredging Co. began dragline operations in the Weaverville district in October and continued until the end of the year. The Viking Dredging Co. continued dragline dredging throughout 1938 on its property at the junction of Redding Creek and Trinity River; a floating washing plant and a dragline with a 2-cubic yard bucket were employed. The Weaver Dredging Co., the first dragline dredge operation in Trinity County, continued production throughout 1938; the company employed two plants. The Pacific Gold Dredging Co., operated a dragline dredge on West Weaver Creek from June 5 until August 21; the equipment consisted of a floating washing plant and a 1-cubic yard dragline bucket.

TUOLUMNE COUNTY

Columbia district.—The Densmore Gold Mines, Inc., treated 1,570 tons of gold ore in its flotation mill in 1938 and shipped the concentrates for smelting; 2,001 ounces of gold and 975 ounces of silver were recovered. The Shoestring Mining Co. worked the Experimental group northeast of Sonora intermittently; 829 tons of ore yielded 121 ounces of gold by amalgamation and 8 ounces of gold by cyanidation of concentrates. The treatment of 1,370 tons of dump material at the National lode claim yielded 97 ounces of gold between September 16 and December 2. Operations at the Sugarman mine yielded 200 tons of ore, from which 228 ounces of gold were recovered during the period of operation from the first of the year to August 15.

East Belt district.—The Columbus Gold Mining Co. mined a large quantity of ore before ceasing operations in 1938. Metallic Mines produced 2,000 tons of gold ore during intermittent operations at the Longfellow mine. Lessees at the Mohrman Mine produced 475 tons of ore, from which 168 ounces of gold were recovered by amalgamation.

Mother Lode district.—Hemming Bros. treated 456 tons of ore by amalgamation and concentration and recovered 126 ounces of gold at the Alameda mine during 1938. Miller & Clemson worked the Eagle Shawmut mine from the first of the year until December 16. During the early months of the year surface ores were treated by cyanidation, but this work was abandoned because of poor recovery; the rest of the year, ore was treated in the company concentrating mill. In all 3,719 ounces of gold and 1,342 ounces of silver were recovered, principally by smelting of concentrates. Gold Diggers Syndicate worked the Heslep, App, Dutch, and Sweeney mines throughout 1938. The ore was treated in the company 50-ton flotation plant; 608 tons of concentrates were produced from 16,445 tons of ore and yielded 2,327 ounces of gold and 1,495 ounces of silver. E. A. Kent operated a dragline dredge on Tuolumne River, Woods Creek, and Curtis Creek. Moccasin Mine operated a dragline dredge on Moccasin Creek throughout 1938. Rim Cam Gold Dredging Co. operated a dredge, using a dragline with a 1-cubic yard bucket, on Woods Creek from April 17 to August 15.

YUBA COUNTY

Bear River district.—Camp Far West Mining Co. suspended all operations at its property 5 miles east of Wheatland August 4, 1938; the company produced 250 ounces of gold from 16,000 yards of gravel, using a nonfloating washing plant to which gravel was delivered by a dragline excavator with ¾-cubic yard bucket.

Browns Valley district.—The Pennsylvania mine, operated by the Empire Star Mines Co., Ltd., was the outstanding lode producer in Yuba County in 1938.

Challenge district.—Operations at the Horseshoe mine in 1938 produced 1,830 tons of gold ore, which yielded 328 ounces of gold by amalgamation and concentration.

Smartville district.—A lessee on the Blue Point drift mine treated 4,688 tons of gravel to produce 267 ounces of gold during 1938. The Williams Bar Dredging Co. handled 2,872,621 cubic yards of gravel in its connected-bucket dredge during the full year's operations and recovered 8,582 ounces of gold and 629 ounces of silver. On Yuba River near Smartville was one of the largest camps of "snipers" in California during 1938; an average of 100 or more men camped along 2 miles of the river throughout the year.

Yuba River district.—Yuba Consolidated Gold Fields operated a fleet of five large electrically operated connected-bucket dredges in the Yuba River district throughout 1938, equipped as to number and capacity of buckets as follows: Eighty-seven 18-cubic foot, one hundred 18-cubic foot, one hundred and twenty-six 18-cubic foot, one hundred 18-cubic foot, and eighty-seven 18-cubic foot buckets. This company's operation was by far the largest in Yuba County and one of the largest single gold-producing operations in California.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN COLORADO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Colorado mines yielded gold, silver, copper, lead, and zinc valued, in terms of recovered metals, at $22,073,663 in 1938 compared with $22,107,207 in 1937. Gold, with no change in price during the 2 years and with only a very small difference in quantity produced each year (less than one-half of 1 percent decrease in 1938 from 1937), represented 58 percent of the total metal value in each year. The quantity of silver and copper produced increased 27 and 30 percent, respectively, in 1938 over 1937, but because of the lower average prices in 1938 the total value increased only 6 and 5 percent, respectively. Silver contributed 23 percent of the total metal value in 1938 and copper 13 percent. Lead production decreased 3 percent, and zinc increased 7 percent in quantity from 1937; lead, however, decreased 25 percent and zinc 21 percent in total value. Most of the principal producers in 1937 of gold, gold-silver, and silver ores and of base-metal ores mined because of their gold and silver content continued operations throughout 1938; and the number of small gold-mining enterprises increased. The output of zinc-lead-copper-silver-gold ore, however, was made almost entirely in the first half of the year, as the State's largest producer of zinc and lead in 1937 was shut down after June 1938, and only a small quantity of zinc, zinc-lead, and complex zincky ores was shipped from other mines in the State in the latter half of 1938.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.

Annual figures for the 5 years ended with 1938, given in the table that follows, show a general upward trend in production over the period and large total gains for all five metals. Colorado has produced more silver in the past than any other State in the United States and ranks second in total recorded output of gold.

Mine production of gold, silver, copper, lead, and zinc in Colorado, 1934–38, and total, 1858–1938, 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
1934	929	967	1, 309, 187	324, 923. 32	$11, 356, 070	3, 475, 661	$2, 246, 892
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
1858–1938			(1)	37, 182, 538. 00	795, 265, 794	692, 441, 670	540, 616, 152

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	11, 294, 000	$903, 520	8, 435, 000	$312, 095	1, 544, 000	$66, 392	$14, 884, 969
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
1858–1938	[2] 212, 179	57, 411, 599	[2] 2, 344, 619	221, 341, 809	[2] 1, 128, 402	158, 400, 516	1, 773, 035, 870

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Colorado, 1934–38, 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
1934	[2] 4,086.39	[2] 855	(2)	(2)	3, 594. 34	533			7, 292. 26	1, 828	14, 972. 99	3, 216
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. 28	433	1, 361. 40	279	10, 201. 31	2, 020	3, 166. 09	279	1, 026. 92	239	18, 041. 00	3, 250

[1] Dragline and power-shovel excavators with sluices or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—The principal gold-producing districts of Colorado in 1938, in order, were the Cripple Creek district, Teller County; Mosquito, Park County; Animas, San Juan County; Summitville, Rio Grande County; Empire, Clear Creek County; Redcliff, Eagle County; Upper San Miguel, San Miguel County; Gold Hill, Boulder County; Sneffels, Ouray County; and Leadville, Lake County. The three largest gold-producing properties in the State during the year were the United Gold Mines, Cresson, and Golden Cycle-Ajax, all in the Cripple Creek district; the London mine in the Mosquito district ranked fourth, Summitville Consolidated Mines group at Summitville fifth, Shenandoah-Dives-Mayflower group at Silverton sixth, Minnesota Mines group at Empire seventh, Eagle mine at Gilman eighth, Smuggler Union group at Telluride ninth, and Camp Bird in Ouray tenth. Substantial gains in gold production were made in San Miguel, Eagle, Rio Grande, Ouray, Boulder, and San Juan Counties. The largest decreases from 1937 occurred in Park, Lake, Summit, La Plata, and Gilpin Counties. Dry and siliceous ores yielded 87 percent of the total gold; copper ore 5 percent; lead, lead-copper, zinc, and zinc-lead ores 3 percent; and placers 5 percent.

Silver.—Eagle County produced 67 percent of the State total output of silver in 1938 compared with 65 percent in 1937 and 63 percent in 1936. San Juan County continued in second place, and San Miguel County rose from fourth in 1937 to third in 1938. Mineral County ranked fourth, followed in order by Ouray, Pitkin, Clear

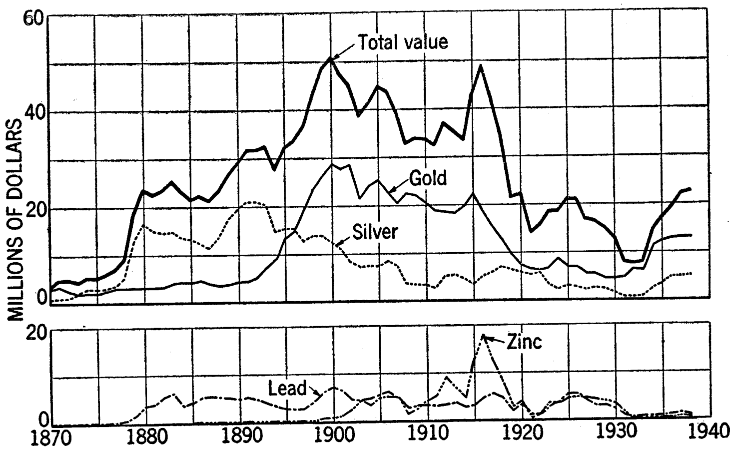

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Colorado, 1870–1938. The value of copper has been less than $2,000,000 annually, except in a few years.

Creek, Saguache, and Lake. The chief silver-producing properties in 1938 were: Eagle mine group, Eagle County; Shenandoah-Dives-Mayflower and Sunnyside groups, San Juan County; Pittsburg-Last Chance-Del Monte group, Mineral County; and Smuggler Union and Butterfly groups, San Miguel County. Copper ore yielded 69 percent of the State total output of silver; dry and siliceous ore 26 percent; zinc-lead ore 3 percent; and other types of ore, together with a very small quantity from placer mines, 2 percent.

Copper.—In 1938 copper production in Colorado surpassed the previous record annual output of 1937 by 6,474,000 pounds and set a new record—28,342,000 pounds. Eagle County produced 85 percent of the State total in 1938 and San Juan County 7 percent; most of the remainder came from Saguache, Ouray, and Clear Creek Counties. The principal copper-producing companies were the New Jersey Zinc Co. Empire Zinc Division at Gilman, Shenandoah-Dives Mining Co. at Silverton, Rawley Mines at Bonanza, and Sunnyside Mining & Milling Co. at Eureka. Copper ore yielded 87 percent of the total copper, dry and siliceous ores 10 percent, and other types of ore 3 percent.

Lead.—The output of lead in Colorado in 1938 decreased 3 percent in quantity and 25 percent in value from 1937. San Juan County produced nearly half of the State total in 1938; Lake, San Miguel, and Eagle Counties each produced more than 1,000,000 pounds. The Sunnyside mine in San Juan County was the largest individual producer of lead in the State during the year. Dry and siliceous ores yielded nearly 39 percent of the total lead, zinc-lead ores 33 percent, lead and lead-copper ores 18 percent, and copper ore 10 percent.

Zinc.—In the 5-year period from 1932 to 1936, inclusive, Colorado produced only 9,078,000 pounds of recoverable zinc, most of which was contained in zinc-lead sulfide ore shipped from Lake County to the pigment plant at Coffeyville, Kans.; in byproduct zinc concentrates derived from dry and siliceous silver ore from Pitkin County; and in zinc-lead-gold-silver-copper ore shipped from widely scattered districts to custom concentrators in Utah. In September 1937 the Sunnyside zinc-lead mine in San Juan County was reopened and was operated through June 1938, producing most of the State output of zinc in 1937 and 1938. No zinc-lead ore was shipped to Coffeyville from Lake County in 1938, but a few operators continued to ship zinc-lead-gold-silver-copper ores to Utah custom mills from Lake and other counties and the Midnight Mining Co. in Pitkin County continued to make byproduct zinc concentrates. In October 1938 the Shenandoah-Dives Mining Co., 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 mill, changed its treatment process from bulk lead flotation (with some zinc concentrates) to selective flotation and thereafter made flotation zinc, lead, and copper concentrates and table iron concentrates.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, 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		11	91.80	$3,213	14	$9
Arapahoe		8	20.00	700	1	1
Boulder	154	11	23,049.40	806,729	38,763	25,059
Chaffee	11	16	472.40	16,534	4,834	3,125
Clear Creek	97	47	33,328.40	1,166,494	130,134	84,127
Conejos	1		12.60	441	916	592
Costilla		2	13.80	483	3	2
Custer	3		145.00	5,075	2,772	1,792
Denver		9	7.40	259		
Dolores	4	4	58.80	2,058	4,927	3,185
Douglas		15	41.20	1,442		
Eagle	10	7	17,445.20	610,582	5,307,342	3,431,009
Elbert		4	17.40	609		
Fremont	2	1	10.20	357	35	23
Garfield	1		157.80	5,523	68	44
Gilpin	65	152	14,165.40	495,789	34,896	22,559
Grand		2	2.00	70		
Gunnison	12	4	828.80	29,008	4,930	3,187
Hinsdale	4		27.40	959	5,496	3,553
Jackson		1	1.20	42		
Jefferson		35	71.80	2,513	14	9
Lake	65	22	11,993.00	419,755	105,661	68,306
La Plata	6	2	229.60	8,036	1,935	1,251
Larimer	1		22.20	777	34	22
Mineral	7		187.20	6,552	457,595	295,819
Moffat		11	640.60	22,421	31	20
Montezuma	3	1	1,891.60	66,206	3,595	2,324
Montrose	2	15	67.60	2,366	568	367
Ouray	13	3	12,760.60	446,621	213,382	137,944
Park	18	117	38,688.20	1,354,087	56,891	36,778
Pitkin	5		.60	21	190,578	123,202
Rio Grande	2		19,768.60	691,901	50,855	32,876
Routt		4	41.00	1,435	19	12
Saguache	11		258.00	9,030	124,825	80,695
San Juan	21	2	26,515.60	928,046	647,712	418,723
San Miguel	24	13	17,134.40	599,704	471,689	304,930
Summit	21	62	2,085.80	73,003	56,085	36,257
Teller	106	11	145,215.40	5,082,539	15,495	10,017
	669	592	367,468.00	12,861,380	7,932,095	5,127,819
Total, 1937	655	490	368,905.00	12,911,675	6,260,693	4,842,646

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Adams							$3,222
Arapahoe							701
Boulder	85,000	$8,330	164,000	$7,544			847,662
Chaffee	4,400	431	212,000	9,752	48,000	$2,304	32,146
Clear Creek	423,000	41,454	685,000	31,510	30,000	1,440	1,325,025
Conejos							1,033
Costilla							485
Custer			24,000	1,104			7,971
Denver							259
Dolores	3,400	333	57,000	2,622	60,000	2,880	11,078
Douglas							1,442
Eagle	24,026,000	2,354,548	1,865,000	85,790			6,481,929
Elbert							609
Fremont	9,400	921					1,301
Garfield	100	10					5,577
Gilpin	23,000	2,254	101,000	4,646			525,248
Grand							70
Gunnison	100	10	19,000	874	29,000	1,392	34,471
Hinsdale	6,500	637	141,000	6,486	6,000	288	11,923
Jackson							42
Jefferson							2,522
Lake	57,000	5,586	2,449,000	112,654	193,000	9,264	615,565
La Plata	100	10	1,900	87			9,384
Larimer							799
Mineral			241,000	11,086			313,457
Moffat							22,441
Montezuma	3,000	294	100	5			68,829
Montrose	13,600	1,333					4,066
Ouray	723,500	70,903	852,000	39,192			694,660
Park	55,000	5,390	838,000	38,548			1,434,803
Pitkin	500	49	440,000	20,240	160,000	7,680	151,192
Rio Grande	10,000	980					725,757
Routt							1,447
Saguache	736,000	72,128	227,000	10,442			172,295
San Juan	2,021,000	198,058	8,011,000	368,506	8,549,000	410,352	2,323,685
San Miguel	138,000	13,524	2,240,000	103,040			1,021,198
Summit	3,400	333	342,000	15,732	31,000	1,488	126,813
Teller							5,092,556
	28,342,000	2,777,516	18,910,000	869,860	9,106,000	437,088	22,073,663
Total, 1937	21,868,000	2,646,028	19,572,000	1,154,748	8,494,000	552,110	22,107,207

Gold and silver produced at lode mines in Colorado in 1938, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Boulder	78,911	22,617.40	38,729
Chaffee	810	219.20	4,797
Clear Creek	223,611	33,233.20	130,120
Conejos	500	12.60	916
Custer	1,549	145.00	2,772
Dolores	393	52.80	4,927
Eagle	327,741	17,427.00	5,307,342
Fremont	64	4.20	34
Garfield	103	157.80	68
Gilpin	50,582	5,829.00	33,510
Gunnison	6,803	823.00	4,930
Hinsdale	1,283	27.40	5,496
Lake	47,766	10,229.40	105,234
La Plata	2,996	222.20	1,935
Larimer	11	22.20	34
Mineral	35,656	187.20	457,595
Montezuma	682	1,890.80	3,595
Montrose	119	1.80	549
Ouray	54,419	12,751.40	213,379
Park	130,105	34,109.00	56,034
Pitkin	27,935	.60	190,578
Rio Grande	37,207	19,768.60	50,855
Saguache	8,357	258.00	124,825
San Juan	331,725	26,511.00	647,712
San Miguel	124,919	17,070.60	471,664
Summit	3,491	670.00	55,723
Teller	498,357	145,185.60	15,492
	1,996,095	349,427.00	7,928,845
Total, 1937	2,068,619	354,034.00	6,258,128

Gold and silver produced at placer mines in Colorado in 1938, 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	91.80	14									91.80	14
Arapahoe	20.00	1									20.00	1
Boulder	28.39	1			403.61	33					432.00	34
Chaffee	69.65	10			183.55	27					253.20	37
Clear Creek	95.20	14									95.20	14
Costilla	13.80	3									13.80	3
Denver	7.40										7.40	
Dolores	6.00										6.00	
Douglas	40.31				.89						41.20	
Eagle	18.20										18.20	
Elbert	17.40										17.40	
Fremont	6.00	1									6.00	1
Gilpin	546.99	101			4,623.32	1,006	3,166.09	279			8,336.40	1,386
Grand	2.00										2.00	
Gunnison	5.80										5.80	
Jackson	1.20										1.20	
Jefferson	71.80	14									71.80	14
Lake	34.00	6			1,729.60	421					1,763.60	427
La Plata	1.70				5.70						7.40	
Moffat	33.61	1			606.99	30					640.60	31
Montezuma	.80										.80	
Montrose	65.80	19									65.80	19
Ouray	9.20	3									9.20	3
Park	664.06	129	1,361.40	279	2,183.58	367			370.16	82	4,579.20	857
Routt	1.77				39.23	19					41.00	19
San Juan	4.60										4.60	
San Miguel	63.80	25									63.80	25
Summit	334.20	88			424.84	117			656.76	157	1,415.80	362
Teller	29.80	3									29.80	3
	2,285.28	433	1,361.40	279	10,201.31	2,020	3,166.09	279	1,026.92	239	18,041.00	3,250
Total, 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

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

A study of the output of individual mines in Colorado in 1938 shows that 35 operations employing 25 to 460 men (totaling 3,384) produced 97 percent of the State output of copper, 93 percent of the zinc, 85 percent of the silver, 74 percent of the gold, and 73 percent of the lead. Compared with 1937 there was a decrease in 1938 of 14 in the number of lode mines employing 25 or more men. Six mines in this group that were active in 1937 suspended production before the end of that year; but one new operator appeared in the group in 1938, and nine continued operations but employed fewer men in 1938 than in 1937. The number employing less than 25 men in 1938, comprising the 9 mentioned above and others, including many small gold mines, prospects, and dumps worked by individuals and groups with a minimum of expense for equipment, increased from 606 in 1937 to 634 in 1938. Data on the total number of men working at the 634 small operations are not available, but the number is considerably larger relative to the quantity of metal produced than at the 35 large operations. Dry and siliceous gold, gold-silver, and silver ores comprised 76 percent of the State total output of ore in 1938; copper ore 17 percent; zinc-lead ore 6 percent; and other types of ore 1 percent.

Approximately 1,841,965 cubic yards of gravel were handled in 1938 by 2 floating connected-bucket dredges and 25 dry-land and dragline floating dredges; 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. Although there was some expansion in placer mining in 1938 resulting in the expenditure of money for equipment, the output of gold from placers amounted to only 5 percent of the State total, and none of the individual operators employed more than 24 men.

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 1938, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	1,071,562	282,183.36	360,262	1,005,965	2,226,457	----------
Dry and siliceous gold-silver ore	379,456	39,117.00	945,449	1,837,495	4,191,895	215,000
Dry and siliceous silver ore	77,640	328.04	767,801	25,920	883,295	160,000
	1,528,658	321,628.40	2,073,512	2,869,380	7,301,647	375,000
Copper ore	333,103	17,131.25	5,421,143	24,750,110	1,960,667	----------
Lead ore	19,646	6,604.45	169,223	47,430	3,356,881	28,000
Lead-copper ore	37	9.36	366	2,500	6,200	----------
Zinc ore	145	11.87	83	----------	2,300	42,000
Zinc-lead ore	114,506	4,041.67	264,518	672,580	6,282,305	8,661,000
	467,437	27,798.60	5,855,333	25,472,620	11,608,353	8,731,000
Total, lode mines	1,996,095	349,427.00	7,928,845	28,342,000	18,910,000	9,106,000
Total, placers	----------	18,041.00	3,250	----------	----------	----------
	1,996,095	367,468.00	7,932,095	28,342,000	18,910,000	9,106,000
Total, 1937	2,068,619	368,905.00	6,260,693	21,868,000	19,572,000	8,494,000

METALLURGIC INDUSTRY

The construction and maintenance of suitable ore-reduction mills and treatment plants have contributed materially to prolongation of the productive life of some of the old gold- and silver-producing districts of Colorado during the past few years. Many of the mines are situated in regions not reached by railroads or main highways, and it is necessary to make concentrated products containing the recoverable commercial metals in forms that can be transported economically to distant points and sold in the markets that offer the highest net return to the operator. Gold and silver recovered as amalgam and retorted and bullion, nuggets, and grains containing 20 percent or more gold or gold and silver combined can be sold direct to the United States mints and assay offices where the total melting, refining, and handling charges average only about 17 cents per fine ounce of gold. For this reason a number of flotation mills use mat-lined launders, jigs, and corduroy blanket or burlap tables in the ball-mill classifier circuit or following the classifier to remove concentrates containing free gold and heavy sulfides for treatment in amalgam barrels or iron arrastre; however, some of the concentrates made in this manner are shipped to smelters. The percentage of the State total lode gold recovered by amalgamation rose from 17 percent in 1934 to 20 percent in 1938; that recovered by cyanidation from 37 to 41 percent; and that recovered in concentrates and from crude ore smelted decreased from 46 to 39 percent.

Mine production of metals in Colorado in 1938, 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 concentrates amalgamated [1]	770,788	69,157.00	24,114			
Ore, concentrates, sands, and slimes cyanided [2]	[3] 591,197	142,858.81	89,849			
Concentrates smelted	77,893	102,703.64	2,017,721	3,471,090	13,759,162	9,064,000
Ore smelted	377,320	34,707.55	5,797,161	24,870,910	5,150,838	42,000
Placer [1]		18,041.00	3,250			
		367,468.00	7,932,095	28,342,000	18,910,000	9,106,000
Total, 1937		368,905.00	6,260,693	21,868,000	19,572,000	8,494,000

[1] Quicksilver purchased (which is close to amount used) by amalgamation mills was 5,193 pounds. Placer mines used approximately 400 pounds.
[2] Cyanide (in terms of 96- to 98-percent NaCN) used was 769,920 pounds.
[3] Comprises 361,177 tons of sands and slimes from ore and iron concentrates first roasted and amalgamated, 195,013 tons of tailings from ore first floated, and 35,007 tons of combined flotation and table concentrates and crude ore cyanided direct.

Owing to changing sources of ore supply and the variance in character and grade of ore produced in different levels of some individual mines many problems in metallurgy occur, and changes in flow sheets of mills constantly are being made; some of the mills are dismantled and new ones built. The mills in operation in Colorado in 1938 varied greatly in size—61 having capacities ranging from 35 to 2,000 tons daily and 32 from 3 to 30 tons daily. Available data on the status of the 61 larger mills show that 11 were new mills that started operations during the year; 20 operated part of the year but were later shut down and were idle as the year ended; 6 were enlarged; and 24 reported no change. All but 5 of the smaller mills were run intermittently, and only 7 treated more than 1,000 tons of ore during the year.

The total ore treated in 1938 by all mills in Colorado handling ores of gold, silver, copper, lead, and zinc was 1,615,755 tons, of which 1,004,840 tons were treated in company mills at mines; 524,177 tons by the Golden Cycle custom roast-amalgamation-cyanidation-flotation mill at Colorado Springs; and 86,738 tons by custom flotation mills in or near the mining districts (some of which also treated company ore included above), comprising the following: The Mining Associates mill at Salina, Boulder Ore Sampling Works at Boulder (ore reshipped to Golden Cycle mill), and Colorado Smelting & Refining Co. plant at Marshall, all in Boulder County; Hoosac, Humboldt, and Ruth mills in the Idaho Springs district, Dumont mill at Dumont, and Silver Leaf (Watrous) mill at Silver Plume, all in Clear Creek County; Bolen and Golden Gilpin mills in Gilpin County; First National and H. G. N. in the Leadville district, Lake County; Creede Mills, Inc., at Creede, Mineral County; W. C. H. mill at Bonanza, Saguache County; and Shenandoah-Dives mill in San Juan County. All the foregoing 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 Chaffee, Clear Creek, Dolores, Hinsdale, Lake, San Juan, and Summit Counties was shipped to custom mills at Midvale and Tooele, Utah.

Direct-smelting ores comprised 19 percent of the State total ore in 1938. The Arkansas Valley lead bullion-leady copper matte smelter at Leadville purchased most of the gold, gold-silver, silver, and gold-silver-lead-copper ores and concentrates shipped to smelters during the year; the remainder was shipped to smelters in other States, as follows: Zinc ore from Gunnison County to Coffeyville, Kans.; zinc concentrates from Lake, Pitkin, and San Juan Counties to Amarillo, Tex.; iron-copper-silver-gold ore from Eagle County, copper-gold-silver concentrates from Clear Creek County, copper-silver ore from Montrose County, and gold-silver-lead 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 from amalgamation and cyanidation mills (with or without concentration equipment) in Colorado in 1938, by counties, in terms of recovered metals

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*
Boulder	54,018	13,837.90	6,568	2,158	3,384.38	20,495	74,000	141,455
Chaffee	16	4.30						
Clear Creek	207,892	23,489.63	7,750	9,370	8,327.62	66,271	389,285	434,097
Custer	1,500	142.20	1,083					
Eagle	60	2.65						
Gilpin	46,444	3,676.42	12,933	2,875	1,752.77	9,211	16,400	44,138
Gunnison	6,182	728.00	473	79	55.61	1,362		4,000
Lake	11,266	862.59	4,088	504	822.30	3,508	270	26,740
La Plata	14	29.17	236					
Larimer	11	22.20	34					
Montezuma	10	884.08	232					
Ouray	26,095	7,608.38	2,135	3,372	3,955.61	89,657	362,500	402,150
Park	30,920	964.93	29,160	1,019	3,382.50	2,975	1,600	100,840
Rio Grande	37,192	9,648.12	27,461	1,805	10,075.79	23,348	10,000	
Saguache	361	33.50	5	18	63.90	26		
San Juan	190	165.42	89					
San Miguel	73,791	5,032.82	6,399	7,909	7,760.53	218,455	2,300	1,397,700
Teller	495,515	144,883.50	15,317					
	991,477	212,015.81	113,963	29,109	39,581.01	435,308	856,355	2,551,120
Total, 1937	941,765	200,337.92	78,217	22,668	31,408.96	277,360	642,445	1,694,970

Mine production of metals from concentrating mills in Colorado in 1938, 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*
Boulder	24,790	2,282	5,307.97	10,824	9,800	21,495	
Chaffee	172	91	75.90	987	3,600	42,600	48,000
Clear Creek	15,048	1,366	1,023.08	43,512	25,365	153,993	17,000
Conejos	500	26	12.60	916			
Dolores	310	104	15.88	1,292	2,200	37,200	60,000
Gilpin	3,898	313	196.74	7,797	500	35,070	
Gunnison	375	13	5.79	158		1,440	
Hinsdale	1,271	180	26.90	5,183	6,380	136,400	6,000
Lake	14,843	1,417	916.03	10,505	4,840	427,350	193,000
La Plata	2,980	37	187.70	1,683		1,800	
Mineral	35,179	937	187.20	441,092		229,300	
Ouray	27,474	1,478	721.90	66,802	348,900	313,150	
Park	97,868	6,562	26,438.05	20,283	49,220	606,160	
Pitkin	14,500	741		88,379	500	265,600	160,000
Saguache	1,400	246	16.10	4,465	14,800	47,100	
San Juan	331,053	27,340	24,007.32	627,739	2,016,700	7,934,500	8,549,000
San Miguel	50,679	5,254	3,678.90	236,528	131,500	706,214	
Summit	2,116	297	2.47	14,093	430	248,670	31,000
Teller	2,842	100	302.10	175			
	627,298	48,784	63,122.63	1,582,413	2,614,735	11,208,042	9,064,000
Total, 1937	801,391	55,977	93,165.27	1,122,202	1,712,782	11,880,481	6,577,000

Gross metal content of concentrates produced from ores mined in Colorado in 1938, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper (wet assay)	Lead (wet assay)	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	19, 762	54, 494. 17	99, 934	217, 098	1, 103, 323	671, 886
Dry gold-silver	720	403. 26	7, 566	4, 573	30, 620	10, 647
Dry silver	61	16. 19	7, 027	810	3, 422	6, 000
Copper	6, 645	4, 532. 26	93, 879	1, 024, 362	141, 122	137, 854
Lead	29, 132	20, 842. 91	1, 344, 401	930, 570	11, 602, 241	2, 793, 938
Lead-copper	10, 803	21, 887. 06	428, 937	1, 818, 752	2, 457, 453	1, 637, 564
Zinc	10, 770	756. 16	59, 233	154, 597	817, 996	10, 637, 650
	77, 893	102, 932. 01	2, 040, 977	4, 150, 762	16, 156, 177	15, 895, 539
Total, 1937	78, 645	124, 631. 02	1, 411, 898	2, 833, 995	15, 683, 798	14, 380, 882

Mine production of metals from Colorado concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	4, 440	8, 692. 35	31, 319	83, 800	162, 950	
Chaffee	91	75. 90	987	3, 600	42, 600	48, 000
Clear Creek	10, 736	9, 350. 70	109, 783	414, 650	588, 090	17, 000
Conejos	26	12. 60	916			
Dolores	104	15. 88	1, 292	2, 200	37, 200	60, 000
Gilpin	3, 188	1, 949. 51	17, 008	16, 900	79, 208	
Gunnison	92	61. 40	1, 520		5, 440	
Hinsdale	180	26. 90	5, 183	6, 380	136, 400	6, 000
Lake	1, 921	1, 738. 33	14, 013	5, 110	454, 090	193, 000
La Plata	37	187. 70	1, 683		1, 800	
Mineral	937	187. 20	441, 092		229, 300	
Ouray	4, 850	4, 677. 51	156, 459	711, 400	715, 300	
Park	7, 581	29, 820. 55	23, 258	50, 820	707, 000	
Pitkin	741		88, 379	500	265, 600	160, 000
Rio Grande	1, 805	10, 075. 79	23, 348	10, 000		
Saguache	264	80. 00	4, 491	14, 800	47, 100	
San Juan	27, 340	24, 007. 32	627, 739	2, 016, 700	7, 934, 500	8, 549, 000
San Miguel	13, 163	11, 439. 43	454, 983	133, 800	2, 103, 914	
Summit	297	2. 47	14, 093	430	248, 670	31, 000
Teller	100	302. 10	175			
	77, 893	102, 703. 64	2, 017, 721	3, 471, 090	13, 759, 162	9, 064, 000
Total, 1937	78, 645	124, 574. 23	1, 399, 562	2, 355, 227	13, 575, 451	6, 577, 000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	19, 762	54, 494. 17	99, 915	174, 122	988, 548	
Dry gold-silver	720	403. 26	7, 566	3, 700	26, 647	
Dry silver	61	16. 19	7, 027	650	3, 000	
Copper	6, 645	4, 532. 26	93, 879	967, 300	77, 700	
Lead	29, 132	20, 842. 91	1, 344, 401	744, 930	10, 432, 324	
Lead-copper	10, 803	21, 887. 06	428, 937	1, 456, 788	2, 214, 638	
Zinc	10, 770	527. 79	35, 996	123, 600	16, 305	9, 064, 000
	77, 893	102, 703. 64	2, 017, 721	3, 471, 090	13, 759, 162	9, 064, 000

Gross metal content of Colorado crude ore shipped to smelters in 1938, by classes of ore

Class of ore	Ore		Gross metal content				
			Gold	Silver	Copper	Lead	Zinc
	Short tons	*Percent of total*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	12,086	3.21	10,756.28	39,461	88,439	218,598	12,013
Dry and siliceous gold-silver	2,047	.54	516.49	28,351	3,767	144,984	15,998
Dry and siliceous silver	15,443	4.09	26.67	167,598	9,626	268,573	
Copper	333,103	88.28	17,131.25	5,421,143	25,554,350	3,573,176	6,001,013
Lead	14,459	3.83	6,255.63	140,159	42,258	2,890,935	127,599
Lead-copper	37	.01	9.36	366	3,019	6,901	6,982
Zinc	145	.04	11.87	83		4,190	50,836
	377,320	100.00	34,707.55	5,797,161	25,701,459	7,107,357	6,214,441
Total, 1937	325,463	100.00	29,125.71	4,780,468	20,140,977	7,743,622	7,758,837

Mine production of metals from Colorado crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Boulder	103	87.15	842	1,200	1,050	
Chaffee	622	139.00	3,810	800	169,400	
Clear Creek	671	392.87	12,587	8,350	96,910	13,000
Custer	49	2.80	1,689		24,000	
Dolores	83	36.92	3,635	1,200	19,800	
Eagle	327,681	17,424.35	5,307,342	24,026,000	1,865,000	
Fremont	64	4.20	34	9,400		
Garfield	103	157.80	68	100		
Gilpin	240	203.07	3,569	6,100	21,792	
Gunnison	246	33.60	2,937	100	13,560	29,000
Hinsdale	12	.50	313	120	4,600	
Lake	21,657	7,628.48	87,133	51,890	1,994,910	
La Plata	2	5.33	16	100	100	
Mineral	477		16,503		11,700	
Montezuma	672	1,006.72	3,363	3,000	100	
Montrose	119	1.80	549	13,600		
Ouray	850	465.51	54,785	12,100	136,700	
Park	1,317	3,323.52	3,616	4,180	131,000	
Pitkin	13,435	.60	102,199		174,400	
Rio Grande	15	44.69	46			
Saguache	6,596	144.50	120,329	721,200	179,900	
San Juan	482	2,338.26	19,884	4,300	76,500	
San Miguel	449	598.35	10,282	4,200	136,086	
Summit	1,375	667.53	41,630	2,970	93,330	
	377,320	34,707.55	5,797,161	24,870,910	5,150,838	42,000
Total, 1937	325,463	29,121.85	4,780,349	19,512,773	5,996,549	1,917,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	12,086	10,756.28	39,461	74,760	195,484	
Dry and siliceous gold-silver	2,047	516.49	28,351	2,750	129,806	
Dry and siliceous silver	15,443	26.67	167,598	7,890	241,265	
Copper	333,103	17,131.25	5,421,143	24,750,110	1,960,667	
Lead	14,459	6,255.63	140,159	32,900	2,615,116	
Lead-copper	37	9.36	366	2,500	6,200	
Total to copper and lead plants	377,175	34,695.68	5,797,078	24,870,910	5,148,538	
Zinc	145	11.87	83		2,300	42,000
	377,320	34,707.55	5,797,161	24,870,910	5,150,838	42,000

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, 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*	
Adams County		11			91.80	91.80		14	14				$3,222
Arapahoe County		8			20.00	20.00		1	1				701
Boulder County:													
Central	16		7,468	4,020.60		4,020.60	475		475				141,028
Gold Hill	65	3	55,926	11,782.80	4.20	11,787.00	31,779		31,779	78,800	153,500		447,872
Grand Island	8	4	2,350	402.00	9.40	411.40	2,421		2,421		8,500		16,355
Magnolia	15		1,821	824.00		824.00	14		14				28,849
Sugar Loaf	29	4	9,066	3,861.20	418.40	4,279.60	2,221	34	2,255	3,000	1,000		151,584
Ward	21		2,280	1,726.80		1,726.80	1,819		1,819	3,200	1,000		61,974
Chaffee County:													
Chalk Creek	1		248	137.20		137.20	1,778		1,778	4,400	57,700	48,000	11,340
Granite	3	16	22	18.80	253.20	272.00	31	37	68		1,000		9,610
Monarch	5		517	43.40		43.40	2,931		2,931		151,300		10,374
Riverside	1		12	17.80		17.80	57		57		2,000		752
Trout Creek	1		11	2.00		2.00							70
Clear Creek County:													
Alice and Empire	16	2	151,128	23,401.00	5.40	23,406.40	32,005		32,005	306,800	3,900		870,159
Argentine	2		3,043	313.80		313.80	11,863		11,863	12,200	36,000		21,504
Griffith	9	1	6,961	318.60	1.00	319.60	18,369		18,369	3,500	46,300		25,534
Idaho Springs	53	44	46,671	5,737.60	88.80	5,826.40	49,486	14	49,500	46,200	520,500	17,000	265,211
Montana	10		6,677	1,164.20		1,164.20	12,389		12,389	49,300	27,000		54,829
Trail Creek	7		9,131	2,298.00		2,298.00	6,008		6,008	5,000	51,300	13,000	87,788
Conejos County	1		500	12.60		12.60	916		916				1,033
Costilla County: Grayback		2			13.80	13.80		3	3				485
Custer County: Hardscrabble	3		1,549	145.00		145.00	2,772		2,772		24,000		7,971
Denver County		9			7.40	7.40							259
Dolores County:													
Lone Cone	1		173	18.51		18.51	285		285				832
Pioneer	3	4	220	34.29	6.00	40.29	4,642		4,642	3,400	57,000	60,000	10,246
Douglas County		15			41.20	41.20							1,442
Eagle County:													
Burns-McCoy		7			18.20	18.20							637
Holy Cross	1		63	6.20		6.20							217
Redcliff	9		327,678	17,420.80		17,420.80	5,307,342		5,307,342	24,026,000	1,865,000		6,481,075
Elbert County		4			17.40	17.40							609
Fremont County	2	1	64	4.20	6.00	10.20	34	1	35	9,400			1,301
Garfield County	1		103	157.80		157.80	68		68	100			5,577

Gilpin County:													
Southern	54	141	40,523	4,487.40	5,066.20	9,553.60	32,291	1,092	33,383	22,200	81,000	------	361,859
Northern	11	11	10,059	1,341.60	3,270.20	4,611.80	1,219	294	1,513	800	20,000	------	163,389
Grand County	------	2	------	------	2.00	2.00	------	------	------	------	------	------	70
Gunnison County:													
Box Canyon	1	------	225	19.60	------	19.60	3	------	3	------	------	------	688
Elk Mountain	2	1	50	2.60	.60	3.20	167	------	167	------	1,300	------	280
Gold Brick	6	------	6,349	791.20	------	791.20	2,571	------	2,571	------	9,300	------	29,782
Quartz Creek	1	------	46	6.00	------	6.00	2,189	------	2,189	100	7,500	------	1,980
Spring Gulch	1	------	93	------	------	------	------	------	------	------	900	29,000	1,433
Taylor Park (Tin Cup)	1	3	40	3.60	5.20	8.80	------	------	------	------	------	------	308
Hinsdale County:													
Galena	3	------	1,183	25.40	------	25.40	4,908	------	4,908	5,850	137,000	6,000	11,225
Lake	1	------	100	2.00	------	2.00	588	------	588	650	4,000	------	698
Jackson County	------	1	------	------	1.20	1.20	------	------	------	------	------	------	42
Jefferson County	------	35	------	------	71.80	71.80	------	14	14	------	------	------	2,522
Lake County:													
California (Leadville)	58	8	45,474	10,044.80	13.60	10,058.40	101,472	3	101,475	56,800	2,444,900	193,000	544,939
Other districts [1]	7	14	2,292	184.60	1,750.00	1,934.60	3,762	424	4,186	200	4,100	------	70,626
La Plata County:													
Animas River	------	2	------	------	7.40	7.40	------	------	------	------	------	------	259
California	6	------	2,996	222.20	------	222.20	1,935	------	1,935	100	1,900	------	9,125
Larimer County	1	------	11	22.20	------	22.20	34	------	34	------	------	------	799
Mineral County: Creede	7	------	35,656	187.20	------	187.20	457,595	------	457,595	------	241,000	------	313,457
Moffat County: Fourmile (Timberlake)	------	11	------	------	640.60	640.60	------	31	31	------	------	------	22,441
Montezuma County	3	1	682	1,890.80	.80	1,891.60	3,595	------	3,595	3,000	100	------	68,829
Montrose County:													
La Sal	2	3	119	1.80	40.20	42.00	549	11	560	13,600	------	------	3,165
Naturita	------	12	------	------	25.60	25.60	------	8	8	------	------	------	901
Ouray County:													
Red Mountain	2	------	22,517	699.80	------	699.80	37,363	------	37,363	348,000	281,400	------	95,695
Ridgway	------	3	------	------	9.20	9.20	------	3	3	------	------	------	324
Sneffels	3	------	25,118	11,508.60	------	11,508.60	92,537	------	92,537	362,000	402,300	------	516,605
Uncompahgre	8	------	6,784	543.00	------	543.00	83,479	------	83,479	13,500	168,300	------	82,036
Park County:													
Alma Placers	------	61	------	------	3,213.40	3,213.40	------	662	662	------	------	------	112,897
Beaver Creek	------	6	------	------	403.00	403.00	------	87	87	------	------	------	14,161
Buckskin	5	4	608	304.40	8.80	313.20	993	1	994	150	20,400	------	12,558
Consolidated Montgomery	2	2	5,929	278.20	39.20	317.40	29,007	8	29,015	------	------	------	29,866
Fairplay	------	18	------	------	167.00	167.00	------	36	36	------	------	------	5,868
Horseshoe	1	------	11	.20	------	.20	147	------	147	------	3,000	------	240
Mosquito	10	1	123,557	33,526.20	17.60	33,543.80	25,887	4	25,891	54,850	814,600	------	1,233,618
Tarryall	------	25	------	------	730.20	730.20	------	59	59	------	------	------	25,595
Pitkin County:													
Lincoln Gulch	1	------	1	.60	------	.60	9	------	9	------	------	------	27
Roaring Fork	4	------	27,934	------	------	------	190,569	------	190,569	500	440,000	160,000	151,165
Rio Grande County: Summitville	2	------	37,207	19,768.60	------	19,768.60	50,855	------	50,855	10,000	------	------	725,757

[1] Includes Granite, Independence, Lackawanna Gulch, St. Kevin, Tennessee Pass, and Twin Lakes districts.

Mine production of gold, silver, copper, lead, and zinc in Colorado in 1938, 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*	
Routt County: Hahns Peak	------	4	------------	------------	41.00	41.00	------------	19	19	------------	------------	------------	$1,447
Saguache County:													
Blake	2	--------	7	1.80	------------	1.80	3	----------	3	500	------------	------------	114
Crestone	2	--------	361	97.40	------------	97.40	31	----------	31	------------	------------	------------	3,429
Kerber Creek	7	--------	7,989	158.80	------------	158.80	124,791	----------	124,791	735,500	227,000	------------	168,752
San Juan County:													
Animas	17	2	219,194	20,640.40	4.60	20,645.00	377,366	----------	377,366	1,360,600	1,992,600	263,000	1,204,152
Eureka	3	--------	112,358	5,841.00	------------	5,841.00	267,953	----------	267,953	660,000	5,982,700	8,286,000	1,115,269
Ice Lake Basin	1	--------	173	29.60	------------	29.60	2,393	----------	2,393	400	35,700	------------	4,264
San Miguel County:													
Iron Springs	7	1	16,322	1,125.60	11.00	1,136.60	145,360	5	145,365	62,800	468,800	------------	161,473
Lower San Miguel	------	5	------------	------------	6.20	6.20	------------	3	3	------------	------------	------------	219
Mount Wilson	4	--------	29	99.00	------------	99.00	153	----------	153	200	300	------------	3,598
Upper San Miguel	13	7	108,568	15,846.00	46.60	15,892.60	326,151	17	326,168	75,000	1,770,900	------------	855,908
Summit County:													
Breckenridge	8	61	1,020	427.20	1,414.80	1,842.00	27,166	362	27,528	850	43,700	21,000	85,367
Montezuma	7	--------	2,124	4.00	------------	4.00	16,284	----------	16,284	2,550	259,000	10,000	23,311
Ten Mile	3	1	138	165.80	1.00	166.80	458	----------	458	------------	23,800	------------	7,229
Wilkinson	3	--------	209	73.00	------------	73.00	11,815	----------	11,815	------------	15,500	------------	10,906
Teller County: Cripple Creek	106	11	498,357	145,185.60	29.80	145,215.40	15,492	3	15,495	------------	------------	------------	5,092,556
Total Colorado	669	592	1,996,095	349,427.00	18,041.00	367,468.00	7,928,845	3,250	7,932,095	28,342,000	18,910,000	9,106,000	22,073,663

ADAMS COUNTY

A sluice within the No. 10 gravel-washing plant of the Brannan Sand & Gravel Co. on Clear Creek north of Denver recovered gold as a byproduct in 1938. Individuals who, with one or two exceptions, engaged in placering along Clear Creek as a spare-time activity recovered many small lots of placer gold which they sold to dealers in Denver. Sluicing of stream gravel on the Russell ranch in sec. 14, T. 2 S., R. 68 W., sixth principal meridian, yielded 4.98 crude ounces of placer gold averaging 0.909 fine in gold and 0.044 fine in silver.

ARAPAHOE COUNTY

In 1938 placer operations by individuals on Cherry and Dry Creeks and their tributaries southeast of Denver recovered small lots of gold dust and amalgam retorts, which were sold to dealers in Denver.

BOULDER COUNTY

The principal market for Boulder County ores in 1938 continued to be the Golden Cycle mill at Colorado Springs and for concentrates the A. V. smelter at Leadville. Carey & Weldon reopened the Boulder Ore Sampling Works April 1 and to the end of the year purchased ore for reshipment to the Golden Cycle mill. The Colorado Smelting & Refining Co. custom mill built near Marshall in 1937 was operated for a few months in 1938 before being placed in the hands of a receiver. Boulder County, 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 in the following review by districts.

Central (Jamestown) district.—The Wano mine at Jamestown was the principal gold producer in the Central district in 1938 and was next to the largest individual producing mine in Boulder County; it was operated by the owner and several sets of split-check lessees, who shipped the ore to the Golden Cycle mill at Colorado Springs. The other producers of a car or more of ore in the district were the Gold Finch, Golden Age, Grouse, Rip Van Dam, and Smuggler.

Gold Hill district.—Slide Mines, Inc., operated its Slide-Klondike group of mines continuously in 1938 and was the largest producer of gold, silver, lead, and copper in Boulder County. The ore is treated in the company 70-ton mill, which uses both the gravity- and flotation-concentration processes. Free gold caught on burlap tables between the classifier and Wilfley tables was amalgamated and shipped to the Denver Mint. Most of the gold and silver and all the copper and lead recovered were contained in concentrates shipped to the Leadville smelter. Mining Associates, Inc., continued to purchase ore from operators in Boulder County for treatment in its custom flotation mill at Salina. The Ingram mine, operated by the company, supplied the largest individual tonnage to the mill. The company also operated the Sunshine mine under lease after September 10. Approximately 10,000 tons of low-grade ore were shipped from the King group in 1938; the ore produced from September to December was treated in the St. Joe mill at Valmont, and the remainder was sold to custom plants. Among other producing mines and dumps in the Gold Hill district in 1938 were the American-Osceola, Black Bird-White Eagle group, Black Cloud, Buena Ventura, Cash, Cold Spring, Dead Medicine, Emancipation, Evans, Evening Star, Fisk, Golden Crown, Golden Harp, Grant, Hawkeye, J. O., Little Johnny, Melvina dump, Nil Desperandum, Pilot, Plow Boy, Richard, Richmond, Scotia, Sun & Moon, Tammany, and Washburn.

Grand Island district.—The output from the Grand Island district in 1938 comprised ore shipped to custom plants from the Amy Paul mine, Bird's Nest-Village Belle group, Caribou, Cross group, Enterprise group, Huron claim, and Shirley group; ore concentrated by gravity in a 20-ton mill at the Norway mine; and a little gold recovered by placer miners on Beaver and South Boulder Creeks.

Magnolia district.—The American X, Ben C. Lowell, Cash-Rebecca, KeKeOnga, Senator Hill, Pickwick, Poorman, and Sac and Fox-Dunraven groups produced nearly all the ore shipped from the Magnolia district in 1938. The mill at the Keystone mine was repaired, and some ore was treated to test the equipment.

Sugar Loaf district.—In 1938 the Poorman group, worked by lessees, continued to be the largest producer of gold in the Sugar Loaf district. Most of the ore was shipped to the Golden Cycle mill. Lessees at the Grand Republic mine shipped 1,550 tons of ore to custom plants, chiefly to the Mining Associates mill at Salina. The other principal producing mines and dumps in the district were the Alpine Horn, Concord, Dime, Dolly Varden, Empress, Herold, Livingston, Logan, Nancy, Recluse, Red Signe, Three Brothers, and Wood Mountain. Ore from the Orphan Boy mine was treated in a small mill above Wallstreet, run for a period in 1938. A dragline and sluicing plant operated on the Giggy placer produced nearly all the district output of placer gold.

Ward district.—The B & M mine was the principal producer in the Ward district in 1938. It was operated under a lease from January 1 to November 15 by Larson & Johnson, who shipped 460 tons of ore containing 610 ounces of gold and 723 ounces of silver. These operators sank a shaft 83 feet and drove 250 feet of drifts. The lease was then transferred to Kissell & Co., who continued production and development to the end of the year. The Brock No. 5, Golden Queen, and Boston mines and the Humboldt and Grandview dumps produced nearly all the remainder of the district output.

CHAFFEE COUNTY

Chalk Creek district (Romley, St. Elmo).—Lessees working the Mary Murphy mine on a small scale continued in 1938 to ship ore containing gold, silver, lead, and copper and a relatively high percentage of zinc to the Midvale (Utah) custom milling plant and selected ore of similar type, but lower in zinc content, to the Leadville (Colo.) smelter.

Granite district.—Only a few lots of ore were shipped from lode mines and prospects in the Granite district of Chaffee County in 1938. Two placer mines in Lost Canyon—the Independent and Lost Canon—each worked with a dragline and land washing and sluicing plant produced most of the placer gold shipped from the district during the year. Individuals recovered small lots of placer dust by sluicing along Arkansas River and Cache Creek.

Monarch district.—The quantity of lead-silver-gold ore shipped to the Leadville smelter in 1938 from mines in the Monarch district increased over 1937. The Lilly mine, which produced most of the ore, was operated by lessees nearly all the year. Several shipments were made from the Christmas of '98, Garfield, and New York claims. The Hawkeye mine, under development from September 1 to December 31, yielded 10 tons of ore.

Riverside district.—The Doris Ruby Mining Co. shipped 12 tons of gold-silver-lead ore to the Leadville smelter in 1938.

Trout Creek district.—A little gold was recovered by hand methods at the Mizpah claim, on which 54 feet of development work were done in 1938.

CLEAR CREEK COUNTY

Alice district (Yankee, Lincoln).—The American Smelting & Refining Co., which had operated the Alice group since March 4, 1936, continued operations in 1938 to October 22, when it closed the mine and 275-ton amalgamation-flotation mill indefinitely, owing to exhaustion of ore. In 1938, as in 1937, this mine was the second-largest producer of gold and the largest producer of copper in Clear Creek County. Ore mined by Gopher State Gold, Inc., lessees of the Ottawa group, was concentrated in the Hoosac mill near the junction of Fall River and Clear Creek. The Reynolds stamp-amalgamation mill was run for a short period in 1938 on ore from the Reynolds group. Ore was shipped to the Golden Cycle mill from the Gold King and Lombard mines, and a small lot was shipped to the Leadville smelter from the Ivan group.

Argentine district.—The upper levels of the Santiago mine were operated in 1938 by a lessee who shipped the ore to custom plants. The Dynamite Metals Co. operated the mill at the mine under lease from May 26 to June 12 on dump material and then gave up its lease. The Santiago Metals Corporation afterward ran the mill for 70 days on ore obtained mostly from the dump. Lessees operated the Sidney Tunnel group of the New East Argentine Mining & Milling Co. 4 months and produced 570 tons of silver-lead ore which were treated by Bennett & Rowe in the Silver Leaf mill at Silver Plume and 2 tons which were shipped direct to the Leadville smelter.

Empire district.—Minnesota Mines, Inc., the largest producer of gold in Clear Creek County in 1938, operated continuously its consolidated group of claims in the area north of Empire. The ore was treated in the 250-ton mill at the mine by concentration on mats in launders and flotation followed by cyanidation of the flotation concentrates. After being treated the flotation concentrates, containing chiefly iron sulfide, were sold to the General Chemical Co. of Denver. The mat concentrates, containing mostly free gold, were amalgamated. Lessees at the Tenth Legion-Gold Dirt-Sprankel-Empress Tunnel group shipped over 1,000 tons of ore, part of which was sold to the Golden Cycle mill at Colorado Springs and part concentrated in custom mills at Dumont and Idaho Springs. The Viking Gold Mines Corporation, lessee of the Conqueror group, subleased the property to Three Leasers, who operated it from July 15 to December 31 and made steady shipments of ore to the Golden Cycle mill. The other producers in the Empire district in 1938 comprised the Bard Creek dump, Gold Bug mine, Gold Fissure, Mint, Omaha, Pittsburg, and Sturm.

Griffith (Georgetown-Silver Plume) district.—The H. G. Venable Co. reopened the Pulaski mine in July 1938 and operated it to the end of the year. The company drove 500 feet of drifts and raises, retimbered 400 feet of tunnel, and installed new rails for tramming. The output of ore (2,189 tons) was concentrated in the Silver Leaf custom mill at Silver Plume and the leased Commonwealth mill at Georgetown. During the first few months of the year the Commonwealth mill was used by the Griffith Leasing Co. to treat ore from the Griffith mine, which was closed later. Ore from the Corry City, Seven Thirty, and Wisconsin dumps was concentrated in the Silver Leaf mill and in the Ruth custom mill at Idaho Springs. Late in the year ore from the Capital Tunnel was shipped to the Ruth mill. A few lots of ore were shipped from other mines and prospects in the Griffith district, including the Johnny Bull, Mineral Chief, and Rio Grande. The Silver Plume Mining & Milling Co. remodeled the Terrible mill and repaired the tunnel portal between the mine and mill.

Idaho Springs district.—In 1938 the Alma-Lincoln Mining Co. treated 31,295 tons of gold-silver-lead-copper ore from its Elliott Barber-Lincoln group in its flotation mill. The company has been a consistent producer since October 18, 1933, in spite of having had serious difficulty in the disposal of tailings during the past 3 years. The Ruth custom mill continued operations on ores received from both Clear Creek and Gilpin Counties. The Humboldt Consolidated Mining Co. operated the flotation mill at the Clear Creek-Gilpin sampler on company and custom ore from January to April, when the company closed the mill and the Lord Byron mine; both remained idle to the end of 1938. Ore from the Dixie mine on Ute Creek was treated in a small amalgamation mill. The Colorado Custom Ore Millers treated ore from the Cardigan mine before suspending operations April 15. J. B. Furstenberg operated the Metropolitan mine and Hoosac mill under lease and treated 882 tons of his ore and 3,736 tons of custom ore from the other mines in Clear Creek County. The Black Eagle group and 60-ton flotation mill were operated for a short period early in the year. Ore was shipped to the Golden Cycle mill, A. V. smelter, Midvale (Utah) custom mill, and local custom mills from many other mines, prospects, and dumps in the Idaho Springs district, including the Bald Eagle mine, Calvin-Remington, Cardigan, Cardwell, Columbia-Summit, Crown Point-Virginia, Edward-Kunegunde, Golden Edge, Idaho Bride, Kangaroo, Red Jacket, Shafter, Stanley, Stephens Placer, and West Gold. Small sluicing operations along Clear Creek yielded placer gold.

Montana district (Lawson, Dumont).—The Clear Creek Consolidated Mining Co. erected a 150-ton flotation mill in 1938 at the portal of Clear Creek-Gilpin Tunnel to treat ore opened by the company development program carried on since 1936 in a group of claims traversed by the adit. The mill was started in June and was operated the rest of the year. The Dumont mill was used to concentrate some custom ore from the Gold Dirt group (Empire district), Jumbo claim (Idaho Springs district), and Santiago group (Argentine district), in addition to the output from the Phoenix mine (Trail district). Development work was done at the Red Elephant group, and some ore was shipped. Ore was shipped to custom plants from the American Sisters dump, Eagle millsite, Franklin D., Golden Nest, Kaverne, Yankee, and other properties in the Montana district.

Trail Creek district.—Mining Associates, Inc., operated the Freeland group of mines continuously in 1938. The ore was concentrated by combined gravity and flotation in the mill at the mouth of the McClelland Tunnel near Dumont. The Phoenix Trail Mining Co. operated the Phoenix mine 182 days in 1938; the ore produced was concentrated in the Dumont mill. Lessees at the Lamartine group produced a substantial tonnage of gold-silver-lead ore, part of which was concentrated in local custom mills and part shipped direct to the Golden Cycle mill and the A. V. smelter. They also shipped a car of zinc-gold-lead-silver ore to the custom concentrator at Midvale, Utah. Ore from the Donaldson (Wheatland)-Little Champion, Lone Tree, Mendic, and Oneida-Stagg groups was shipped to the Golden Cycle mill and the Ruth mill.

CONEJOS COUNTY

In 1938 Stunner Mines, Inc., built a mill at the Eurydice group at Stunner 43 miles southwest of Monte Vista and operated it 6 weeks on ore from the Eurydice dump. The equipment of the mill consists of a jaw crusher, 4- by 4-foot ball mill, jig, table, classifier, and four-cell flotation machine. The mine shaft was unwatered to a depth of 300 feet, and some of the drifts were cleaned out and retimbered.

COSTILLA COUNTY

Grayback district.—A watchman at the property of the Drum Estate produced placer gold by sluicing gravel in Grayback Gulch during the summer of 1938. A little gold was recovered from the Griffith placer.

CUSTER COUNTY

Hardscrabble district (Westcliffe, Silver Cliff).—Shore, Kettle, Henning, & Stroehlke operated their 10-ton cyanide plant at Silver Cliff a few months in 1938 on material trucked from a tailings dump on the Nemaha-William property. Gold-silver precipitates produced were shipped to the Midvale (Utah) refinery. Smelting ore was shipped from the Defender and Little Annie claims.

DENVER COUNTY

A few of the individuals who tried sluicing on Platte River and Cherry Creek in Denver in 1938 recovered a little gold.

DOLORES COUNTY

Lone Cone district (Dunton).—The Modern Gold Mines, Inc., continued development of the Emma mine for several months in 1938 and made a test run in the mill, using 165 tons of ore. The concentrates produced and a little crude ore were shipped to the Leadville smelter.

Pioneer district (Rico).—The output from the Pioneer district in 1938 comprised 220 tons of zinc-lead-silver ore shipped to custom flotation plants and smelters in Utah from the Pro Patria group, Nora Lilly claim, and Rico Townsite, all worked by lessees. The

Rico Argentine Mining Co. carried on development work at its property and late in the year constructed a 150-ton selective flotation mill equipped to make three products—lead concentrates, zinc concentrates, and copper-iron concentrates; however, production was not begun in 1938. The mine was an important producer of zinc, lead, silver, and copper prior to 1931. The St. Louis Smelting & Refining Co. continued developing its property. A little placer gold was recovered by individuals sluicing on Dolores River.

DOUGLAS COUNTY

Intermittent small-scale placer mining in 1938 on Cherry and Dry Creeks and Newlin and Russellville Gulches near Parker and Franktown resulted in the recovery of many small lots of gold dust that were sold to dealers in Denver.

EAGLE COUNTY

Burns and McCoy district.—Placer gold was produced by sluicing on the Colorado River near Burns.

Holy Cross district.—The Hunky Dory claim was worked on a small scale from July 1 to November 1, 1938. Part of the ore produced was treated in a small stamp-amalgamation mill on the property, and part was shipped to other plants for testing.

Red Cliff district (Battle Mountain).—The Empire Zinc Co., subsidiary (changed July 1, 1938, to Division) of the New Jersey Zinc Co., operated its Eagle mine group at Gilman continuously in 1938. The mine has been an annual producer since the company began developing it in 1912. In 1929 a 600-ton underground flotation mill was built and placed in operation, and in 1930 the mine was the principal producer of silver, copper, and zinc in Colorado and an important producer of lead and gold. Mining of zinc-lead ore was suspended in 1931, and the mill was closed and has remained idle through 1938. From 1931 to 1938, inclusive, the mine has continued to be the State's largest producer of silver and copper and a substantial producer of gold from copper-iron-silver-gold sulfide ore shipped to smelters, mostly to the copper smelter at Garfield, Utah. This ore contains comparatively small quantities of lead and zinc; some of the lead is recovered, but none of the zinc is saved. The output from other mines in the Red Cliff district during the year comprised gold-silver-copper ore shipped to smelters from the Alpine, Ben Butler, Cora, Evening Star, Ground Hog, Star of the West, and Tip Top properties and a 2-ton lot of gold ore shipped to a smelter from a prospect.

ELBERT COUNTY

Individuals sluicing at small placers near Elizabeth recovered placer gold in 1938.

EL PASO COUNTY

GOLDEN CYCLE MILL

The Golden Cycle custom mill at Colorado Springs ranked fourth among producers of gold in the United States (including Alaska) in 1937. In 1938 it treated 524,177 tons of ore having an average gross value of $10.83 per ton, of which 480,105 tons were gold-[silver]-

sulfotelluride ores from the Cripple Creek district, Teller County, and 44,072 tons comprised miscellaneous gold, gold-silver, and gold-silver-lead-copper ores from other districts, mainly in Boulder, Clear Creek, Gilpin, and Lake Counties. The mill, built in 1907 as a 1,200-ton roast-amalgamation-cyanidation plant, has been operated continuously ever since and has been enlarged to make use of the flotation- and gravity-concentration processes in handling low-grade Cripple Creek ores and miscellaneous ores containing base metals. In 1938, as usual, average-grade Cripple Creek ores comprised most of the mill feed. These ores, with which were mixed iron concentrates made from low-grade ores, were roasted, amalgamated,[1] and cyanided. Miscellaneous ores containing appreciable quantities of base metals were treated by selective flotation. The tailings from all operations were separated into sand and slime fractions and cyanided. The mill recovered 99 percent of its total gold output in the form of gold-silver bullion; the remaining 1 percent was contained in lead-copper concentrates shipped to the Leadville smelter. Equipment for firing the roasters with pulverized coal was installed in 1937. Improvements made in 1938 included the installation of a large crusher to replace a smaller one in the primary crushing plant and the placing of screens ahead of the jaw crusher and Symons cone crushers, which, with changes in the secondary crushing equipment, raised the capacity of these units and reduced the number of daily shifts necessary for the crushers to run. The more efficient crushing equipment furnished finer material to the ball mills in the concentration department and raised the capacity of this section from 450 to 550 tons daily. Economies effected by these improvements and those made in other departments of the mill during the past few years enabled the management to try to stimulate development work and prolong the productive life of the Cripple Creek district by a revision, effective December 1, of the mill schedule of gold payments and treatment and freight rates designed to increase the revenue to the shipper by approximately 40 cents per ton on ore having a gross value of $5 a ton and ranging up to $1.15 per ton on ore valued at $11.30 a ton.

FREMONT COUNTY

A car of copper ore each was shipped from the Green Mountain and the Copper Gulch Mining Co. properties near Parkdale to the Garfield (Utah) smelter in 1938. A little placer gold was recovered by sluicing at the old Dorcas millsite at Florence.

GARFIELD COUNTY

Rifle Creek district.—A lessee worked the Gray Eagle mine 8½ miles north of New Castle during the last 6 months of 1938 and shipped to smelters 103 tons of gold sulfide ore containing a little silver and copper. The development work done comprised a 60-foot winze, 50 feet of drifting, and 30 feet of raising.

GILPIN COUNTY

Southern districts (Blackhawk, Central City, Nevadaville, Russell Gulch).—Production of metals in 1938 from lode mines in the southern

[1] Free gold saved on lightweight canton-flannel blankets and amalgamated in iron arrastre.

districts of Gilpin County declined from 1937, owing to the shutdown after February of "The Patch" property and large Chain O'Mines mill at Central City and the idleness nearly all the year of the Bobtail Tunnel group and Gregory-Bates mill at Blackhawk, active throughout 1937. In 1938 the Gold Ridge Mining Co. did 1,000 feet of drifting at the Clay County group and erected a 75-ton flotation mill. The mill began treating ore in August and continued in operation to the end of the year. During the year the Gunnell, Corydon, Phoenix, Huddleston, and Buell claims in the consolidated group owned by the California-Hidden Treasure Mines Co. produced a total of 993 tons of ore, which yielded 215 ounces of gold and 740 ounces of silver. In addition, 13,000 cubic yards of placer gravel on the Buell claim, handled by a power shovel and screening and sluicing plant on skids, yielded 214 fine ounces of gold and 42 fine ounces of silver. A 15-ton stamp amalgamation-table concentration mill was run throughout the year at the New Brunswick mine. Colorado Silver Mines, Inc., ran its 100-ton flotation mill intermittently on ore from the Black Jack group. The Golden Gilpin custom mill at Blackhawk was operated for a few weeks, mostly on material obtained from dumps. The War Dance mill was reconditioned and was run about 30 days on ore from the Crown Point mine in Clear Creek County. The Big Four Mining & Milling Co. treated ore from the Kirk mine for a period after August in the remodeled Bolen mill. The mine was operated earlier in the year by Raoul Mines, Inc., which shipped ore to other custom plants. Small-scale mining carried on all or part of the year at the following mines and dumps resulted in the shipment of ore to custom mills, chiefly the Golden Cycle mill at Colorado Springs: Becky Sharpe, Columbus-Lotus, Druid, Federal, Frontenac, Golden Cloud, Golden Dollar, Iowa, Justice, Morning Star, Pewabic group, Robert Fulton, Snowden, Stewart, Wautauga dump, West Notoway, and others.

The Manion Placer Co. operated its dragline and land dredge on the Eugene placer on North Clear Creek below Blackhawk 186 days in 1938 and was the largest producer of gold in Gilpin County during the year. Placer ground on the Missions Mines Co. property in Russell Gulch was worked from March to December with a ½-cubic-yard dragline and sluices. Small sluicing operations were carried on by many individuals in the vicinity of Blackhawk and Central City and on North Clear Creek below Blackhawk.

Northern districts.—The Dirigo Mining Co. operated the Dirigo mine and amalgamation-flotation mill through most of 1938. The Tip Top Mines, Inc., worked the Perigo group under lease part of the year and treated some ore in the mill at the mine. Ore was shipped to the Golden Cycle mill from the Lone Star, Martha, Mitchell, Newport, Semiprone, and other properties. The Gilpin County Gold Mining Corporation ceased production early in the year at the We Got Em and Cowboy group at the head of Silver Creek. 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 second season, which lasted from April 10 to December 13. The yield from 419,958 cubic yards of gravel handled was 3,166 fine ounces of gold and 279 fine ounces of silver. F. R. Wolfe operated a dragline excavator and special land sluicing plant in Lump Gulch from April 15 to June 20 and recovered 63 fine ounces of gold. Small sluicing operations in Gamble and Lump Gulches yielded some gold.

GRAND COUNTY

Prospectors sluicing on Bronco Creek and Colorado River recovered a little gold in 1938.

GUNNISON COUNTY

Box Canyon district.—A lessee at the Independent mine, 6 miles south of Pitkin, erected a mill consisting of a crusher, four rapid-drop stamps, amalgamation plates, and launders in which he treated 225 tons of ore in 1938 and recovered 19.60 fine ounces of gold and 3 fine ounces of silver.

Elk Mountain district.—Some development work was done and a 10-ton gravity-concentration mill installed in 1938 at the Baxter property. The only metal produced was contained in 1.3 tons of gold-silver-lead concentrates made from 25 tons of ore run through the mill for testing. A car of smelting ore was shipped from another property in the Elk Mountain district, and a little gold was recovered from a placer in Washington Gulch.

Gold Brick district.—The Carter Mines Co. continued production in 1938 from the Carter 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, which has a capacity of 125 tons daily and treats the ore by amalgamation and gravity concentration. The Old Tom Mining Co. treated 150 tons of ore from the Cortland group in the leased Roosevelt mill near Pitkin early in 1938 and also shipped some ore to smelters. Operations were discontinued after April 15 and the company gave up its lease on the mine. A car of gold-silver-lead ore was shipped to the Leadville smelter from the Bertha mine. A little gold was recovered by amalgamation at the Idoline, Wayne, and one other property in the Gold Brick district.

Quartz Creek district.—Lessees at the Fairview group shipped 46 tons of silver-lead-gold ore to the Leadville smelter in 1938.

Spring Gulch district.—A lessee at the Doctor group shipped 93 tons of zinc carbonate ore early in 1938 to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans.

Taylor Park (Tin Cup) district.—Ore treated in a small mill at the Red Buck-Trail Horse group of lode claims yielded a few ounces of gold in 1938. Individuals sluicing on Willow Creek and other streams in Taylor Park recovered small quantities of placer gold.

HINSDALE COUNTY

Galena district.—The M. B. Burke Investment Co. operated its flotation mill in 1938 at the Ute and Ulay group on Henson Creek from June 15 through November. Material containing zinc, lead, gold, silver, and copper was shipped from the Mill Placer to the custom concentrator at Midvale, Utah. Twelve tons of silver-lead ore from a stope in the California mine were trucked to the Leadville smelter.

Lake district.—In 1938 the Ramsey Brothers Gold Mining & Milling Co. treated 100 tons of silver-lead-gold-copper ore from the Gladiator mine by gravity concentration; the yield was 12 tons of concentrates, sold to the Leadville smelter.

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JACKSON COUNTY

A placer miner recovered a little gold on Independence Mountain northwest of Walden in 1938.

JEFFERSON COUNTY

Individuals continued small-scale intermittent sluicing operations along Clear Creek in 1938 and produced many small lots of placer gold, which were sold to refiners, assayers, and the mint in Denver.

LAKE COUNTY

LEADVILLE DISTRICT

Leadville continued to be the center of the smelting industry of Colorado in 1938. The American Smelting & Refining Co. operated its Arkansas Valley lead bullion-leady copper matte smelter continuously (one furnace) on ores and concentrates purchased from operators in virtually all the active mining districts of the State; receipts from Colorado totaled 107,335 tons compared with 122,235 tons in 1937. In 1938 small lots of ore from New Mexico and Wyoming and 82 tons of combined ore and concentrates from South Dakota were received.

Compared with 1937 the output of ore from lode mines and dumps in the Leadville district in 1938 decreased 74 percent, and the total value of the recovered gold, silver, copper, lead, and zinc decreased 55 percent. The 400-ton Leadville Metals mill, which in 1937 treated 124,457 tons of low-grade dump material containing chiefly gold but also some recoverable silver, copper, and lead, was closed February 2, 1938, and remained idle throughout the rest of the year. However, new mills placed in operation in 1938 by the London Deep Mines Co. at the First National shaft and the H. G. N. Mining & Milling Co. on the Henriett claim treated a total of 10,800 tons of material from dumps in the district. Low-grade ore was shipped from the Ballard, Breece, "Lilian", and President dumps to the Golden Cycle mill at Colorado Springs. Most of the output of newly mined ore and that sorted from dumps was sold direct to the A. V. smelter, but some was shipped to the Golden Cycle mill. No zinc-lead ore was shipped from the district to the pigment plant at Coffeyville, Kans., in 1938, and there was a large decrease from 1937 in the quantity of zinc-lead-gold-silver-copper ore shipped to the custom concentrator of the United States Smelting, Refining & Mining Co. at Midvale, Utah; the only important producer of this type of ore in 1938 was the Fortune mine. Lessees continued production of gold ore from the Ibex group. Some of the other producing mines and dumps in 1938 follow: Chippewa, Commerce, Dolly B, Eliza dump, El Paso dump, Fanny Rawlings, Highland Chief and Highland Mary, Iron Hat, Lilian (mine), Matchless, New Monarch, Ollie Reed, Little Ellen, St. Louis, Morning Star dump, Resurrection, Sunday dump, Tenderfoot, Tribune, Triumph, and Venir. Individuals sluicing in California Gulch recovered placer gold.

Granite district.—The output from the Lake County part of the Granite district in 1938 comprised gold, silver, and lead contained in ore and a small quantity of bullion shipped from the Belle of Granite mine and placer gold produced by individuals sluicing mostly on Arkansas River.

Lackawanna Gulch district.—The Eureka Saturday Night Mining Co. drove 400 feet of tunnel and raises at the Eureka-Saturday Night group in 1938 and erected a 50-ton jig- and flotation-concentration mill which was run during the latter half of the year. Some ore from the Mt. Champion group was treated in a mill installed on the property in 1938.

St. Kevin-Sugar Loaf district.—Edward P. Chapman shipped 111 tons of gold-silver ore to the Leadville smelter from the Amity mine, operated from June to December 1938. Several hundred tons of siliceous silver ore from the St. Kevin dump were hauled to the First National mill near Leadville and treated by flotation.

Tenmile (Climax, Fremont Pass) district.—The Climax Molybdenum Co. at Climax, 13 miles north of Leadville, operated its flotation mill at a daily average of 12,000 tons for 362 days in 1938 and produced concentrates containing 28,242,085 pounds of elemental molybdenum, the largest annual output in the history of the mine.

Tennessee Pass district.—A dragline-dry land dredge installed in the summer of 1938 on the Columbia placer in Tennessee Gulch about 5 miles north of Leadville was operated from July 1 to September 1 and handled 150,000 cubic yards of gravel yielding 563.02 ounces of retorts and grains, which after being melted at the Denver Mint weighed 470.95 ounces and averaged 0.888 fine in gold and 0.088 fine in silver.

Twin Lakes district.—Small lots of smelting ore were shipped from the Gordon-Tiger and Columbine lode claims in 1938. The dragline-dry land dredge on the Derry Ranch placers was operated from May to November.

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 1938.

Animas River district.—Testing of placer ground on Animas River north of Durango resulted in the recovery of a few ounces of gold in 1938.

California (or La Plata) district (Hesperus, La Plata).—Pioneer Gold Producers, Inc., operated the Idaho mine and mill from January 1 to April 8, 1938, after which both were idle to the end of the year. The property was sold to Consolidated Gold Producers, Inc., as of July 1, 1938, and the former operating company was dissolved. Lessees did some work at the May Day mine, equipped with a 50-ton flotation mill, and shipped small tonnages of crude ore to the Golden Cycle mill and concentrates to the Leadville smelter. A little ore was shipped from the Hazel M claim, Old Story, Tomahawk, and an unidentified claim. The Amparo Mining Co. ceased development work at the May Rose group.

LARIMER COUNTY

Small lots of sorted high-grade gold ore were shipped in 1938 from the Little Mary Mason mine in the Masonville district to the Golden Cycle mill.

MINERAL COUNTY

Creede district.—The local market for ore furnished throughout 1938 by the custom flotation mill of Creede Mills, Inc. (inadvertently called Creede Mines, Inc., in Minerals Yearbook, 1938, p. 271), stimulated production in the Creede district and resulted in an increase of 42 percent over 1937 in the district output of silver. In 1938 the company treated 35,179 tons of ore, of which about 70 percent was newly mined and 30 percent came from dumps. The heads into the mill averaged 0.006 ounce of gold and 18.2 ounces of silver to the ton and 1.35 percent lead. The ratio of concentration was 38 tons into 1, and the concentrates averaged 0.20 ounce of gold and 471 ounces of silver to the ton and 13.6 percent lead; they were shipped to the Leadville smelter. The following properties supplied the ore treated in 1938: Alpha-Corsair, Amethyst, Commodore-Bachelor, and New York-Last Chance-Del Monte-Pittsburg groups and Manitoba and Monon mines. Lessees working the Ochre mine shipped ore direct to the Leadville smelter.

MOFFAT COUNTY

Fourmile (or Timberlake) district.—Eldorado Gold Placer Mines continued production in 1938 from its placer ground about 29 miles north of Craig, worked with a gasoline-powered dragline excavator and dry-land dredge. The season's operations lasted from May 14 to October 12. Sluicing at the Old Faithful, Sage Hen, and other placers in the Fourmile district recovered some gold.

MONTEZUMA COUNTY

The Red Arrow Gold Corporation worked the Red Arrow mine in the East Mancos River area continuously in 1938. Production totaled 638 tons of ore yielding 1,744.08 fine ounces of gold, 3,447 fine ounces of silver, and 2,500 pounds of recoverable copper. The richest ore was crushed and amalgamated in a small mill at the mine, and the rest was shipped to smelters. The company did 1,000 feet of development work in the mine during the year. The Barr-Menefee Mining Co. drove 100 feet of tunnel at the Stafford group and shipped 21 tons of gold-silver-copper-lead ore to the Midvale (Utah) smelter. Gold-silver-copper ore was shipped from the Omaha Placers property, adjoining the Red Arrow group. A little gold was recovered from a placer claim on East Mancos River.

MONTROSE COUNTY

La Sal district.—Lessees at the Cashin and Sunrise claims shipped 119 tons of copper-silver ore to the Garfield (Utah) smelter in 1938. Placer miners, with pumps and sluices, continued to recover placer gold on Dolores River.

Naturita district.—Small sluicing operations on San Miguel River recovered placer gold in 1938.

Paradox Valley district.—The United States Vanadium Corporation operated its vanadium mines and roasting and leaching plant at Uravan continuously in 1938, producing at the rate of 240 tons of ore daily and drawing at will the grade of ore desired. Production of the finished product was greater than in 1937. 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 the Treasury Tunnel group from January to October 1938, but production was interrupted for a few weeks in April when the blacksmith shop and some other buildings burned and had to be rebuilt. The ore was treated in the company 300-ton selective flotation mill. The product of the mill was copper concentrates and lead-copper concentrates, both of which contained gold and silver and some zinc. Although production ceased in October the company planned to continue the drift on the Handicap vein about 300 feet farther and then crosscut to the Barstow vein. Ore produced at the Meldrum-Hoffman group, under development by G. A. Franz, was treated in the G. A. Franz flotation mill 2 miles north of Ouray.

Ridgway district.—Small placer operations on Uncompahgre River near Ridgway produced placer gold in 1938.

Sneffels district.—King Lease, Inc., made an increased output over 1937 of gold-silver bullion and gold-silver-lead-copper concentrates from its amalgamation-flotation mill, run continuously in 1938 on ore from the Camp Bird mine. The capacity of the mill is 75 to 100 tons daily. The company extended its development and mining below the third level and started development (specified upon renewal of its lease) in the west heading of the lower adit level 1,450 feet below the third level. Sublessees at the Humboldt group near the line between San Miguel and Ouray Counties shipped a car of silver-gold-lead ore sorted from the dump to the Garfield (Utah) smelter. A little gold was recovered from 10 pounds of ore from the Alma claim reduced and amalgamated by hand.

Uncompahgre district.—A lessee on the property of the Bachelor Development Co. shipped several hundred tons of silver-lead ore to smelters in 1938. G. A. Franz treated ore from the Wedge and Bachelor dumps in his flotation mill from March 15 to May 25. A lessee at the Pony Express-Upper Bachelor group shipped silver-lead ore to the Leadville smelter. The McCullough Lease shipped gold-silver-copper ore to the Leadville smelter from the American Nettie, O & N, and Wanakah groups, worked as a unit, and treated 1,000 tons of old tailings from the Wanakah mill dump in a flotation mill on the property. Smelting ore was shipped from other properties in the Uncompahgre district under development in 1938, including the Mineral Farm, Ophir, and Senorita Extension groups.

PARK COUNTY

Alma Placers district.—Lessees continued sluicing, drift mining, and power shovel operations on leased blocks of the Alma placers in 1938. Among the important producers were the Alplaco Mining Co., Logue, R & W, and Richards leases.

Beaver Creek district.—The Timberline Dredging Co. set up a connected-bucket electric-powered floating dredge with a capacity of 5,000 cubic yards daily on ground of the Placers Realty Co. on Beaver Creek 1½ miles north of Fairplay and began production October 25, 1938. The bucket line has 88 buckets, each with a capacity of 7½ cubic feet. Most of the machinery was obtained from the dismantled Continental dredge formerly in Summit County. The dredge was operated intermittently to December 16 and handled about 115,000 cubic yards of gravel, which yielded placer gold weighing 465.53 ounces after being melted at the Denver Mint and averaging 0.795 fine in gold and 0.175 fine in silver. Individuals recovered placer gold by sluicing and hydraulicking at the Shelton and other placers on upper Beaver Creek during the summer months.

Buckskin district.—Most of the metal output of the Buckskin district in 1938 was contained in gold-silver-lead ore shipped to the Leadville smelter by lessees at the Union No. 5 mine. The other producers were the Excelsior and Silver Wave groups, both equipped with small concentration mills; Phillips, under development throughout the year; and another property producing less than a ton of ore. A little gold was recovered from placers in Buckskin Gulch.

Consolidated Montgomery district.—Alma Syndicate, Inc., operated its cyanide mill on the Tolstoi claim on Mount Bross at an average daily rate of 52½ tons for 110 days in 1938 on gold-silver ore mined with a power shovel from open-cuts on the Morning Star group. The mine was operated from July 19 to November 19; 200 feet of development work were done underground, and 15,000 tons of surface material were stripped. Starting in October 1938 the Magnolia Gold Mining Co. remodeled the mill at the Magnolia mine and late in the year treated 150 tons of gold ore by flotation and gravity concentration. Some placering was done in Montgomery Gulch during the year.

Fairplay district.—Individuals continued to recover placer gold in 1938 by sluicing along Platte River west and south of Fairplay.

Horseshoe district.—The Cole Colorado Co. shipped 11 tons of silver-lead ore from the Peerless group to the Leadville smelter in 1938.

Mosquito district.—The output of gold from the Mosquito district in 1938 decreased 10,919 ounces (25 percent) from 1937. The London Mines & Milling Co., which ranked first among gold producers in the district and fourth in the State in both years, operated the consolidated London, London Extension, and "North London" groups through the 4,400-foot London Extension tunnel continuously in 1938. The ore was treated in the company 200-ton mill by combined gravity and flotation concentration. Besides gold, the flotation concentrates shipped contained some silver, a little copper, and substantial quantities of lead and zinc; the zinc was not saved at the Leadville smelter, to which the concentrates were sold. The London-Butte Gold Mines Co., the second-largest operator in the district, continued production from the Butte mine and 100-ton flotation mill. The mine workings are reached through a vertical shaft 512 feet deep. Development work done in 1938 totaled 2,763 feet. The yield from 20,737 tons of ore treated was 1,940 tons of concentrates averaging 2.96 ounces of gold and 1.67 ounces of silver to the ton, 4.50 percent lead (wet assay), and 2.22 percent zinc. W. A. Ellis, Inc., shipped high-grade gold ore from the American mine to the Leadville smelter. The Chicago Mines Co. treated 24,793 tons of ore from the South London dump in the Record mill. The concentrates produced averaged 3.35 ounces of gold to the ton and contained some recoverable silver and lead. Concentrates caught in launders and amalgamated in a barrel yielded 688 fine ounces of gold. Among other producers in the district in 1938, operated part of the year, were the Hock Hocking, Nova Zembla, Orphan Boy, and Susquehanna. Prospecting and testing were done at the Pennsylvania Mountain placer, which has yielded some gold annually from intermittent small-scale operations during the past few years.

Tarryall district.—The Peerless Mining Co. operated its gasoline-powered 1¼-cubic yard shovel and portable Ainlay four-bowl washing machine for the fifth consecutive season on the Wilson placer 7 miles southeast of Como. In 1938 the plant was run from April 27 to November 3 and handled 79,135 cubic yards of gravel. Individuals sluicing on Tarryall Creek recovered small lots of placer gold. Examination including rechecking of extensive pits and churn-drill holes on the Fortune Placer, Peabody Placer, and Cline Ranch old river channels was done in 1938. Additional gold-bearing yardage was developed and adjacent property purchased.

PITKIN COUNTY

Lincoln Gulch district.—A small lot of gold-silver ore was shipped to the Leadville smelter from the Three Brothers claim in 1938.

Roaring Fork district (Aspen).—Shipments of silver ore containing lead and lime to the Leadville smelter were continued in 1938 from the Smuggler and Spar Consolidated properties, both under the management of D. P. Rohlfing. The Midnight Mining Co. treated 5,000 tons of siliceous silver ore from the Midnight group in the company 50-ton flotation mill. The products of the mill were 238 tons of lead concentrates, averaging 256 ounces of silver to the ton and 54.6 percent lead (wet assay), shipped to the Leadville smelter; and 201 tons of byproduct zinc concentrates, averaging 20.5 ounces of silver to the ton, 1.5 percent lead (wet assay), and 47 percent zinc, shipped to the Amarillo (Tex.) zinc smelter. During the year the company sank a 50-foot winze and drifted 50 feet to cut the ore body below the level of the main 6,700-foot adit. The Metals Recovery Co. operated the Hunter Creek mill for a period in 1938 on dump material, mostly from the Franklyn mine dump. A car of smelting ore was shipped from the Hope mine.

RIO GRANDE COUNTY

Summitville Consolidated Mines, Inc., operated its group of mines and mill at Summitville continuously in 1938. The mining and milling methods and costs at this property as of August 1937 have been described by Guiteras.[2] Extensive development of the property since 1934 has resulted in a steady annual increase in production, and in 1938 the company ranked fifth in the State in gold output. During the year the company discontinued use of the flotation machines and tables, installed a jig in the ball-mill circuit to remove a high-grade sulfide concentrate for shipment direct to the smelter, and then treated the remainder of the pulp by the all-slime cyanide process. The precipitates are smelted at the mine and the bullion produced is shipped to the Denver Mint. Lessees at the Guadalupe property at Jasper shipped a 15-ton lot of gold-silver ore to the Leadville smelter in 1938.

[2] Guiteras, Jos. R., Mining and Milling Methods and Costs at the Summitville Consolidated Mines, Inc., Summitville, Colo.: Bureau of Mines Inf. Circ. 6990, 1938, 23 pp.

ROUTT COUNTY

Hahns Peak district.—The Hornet Gold Mining Co., working placer ground in Ways Gulch with a dragline-dry land dredge from May to September 1938, handled 21,000 cubic yards of gravel. Individuals produced a little gold by sluicing in the same area. No production was made from lode mines in the Hahns Peak district in 1938.

SAGUACHE COUNTY

Blake district.—Development work in 1938 at the Copper Head claim resulted in the shipment of 4 tons of gold-copper ore to the International smelter at Tooele, Utah. The Cotton Creek Mining Co. shipped a test lot of copper-silver ore to the Garfield (Utah) smelter.

Crestone district.—Ore from the Eastern Star mine, one of the claims in the group in the mineral section of Baca Grant No. 4 under lease to the Luis Maria Baca Mining & Development Co., was treated by amalgamation and flotation in the company mill on Cottonwood Creek. A lessee at the Sunbeam claim recovered 15¾ pennyweight of amalgam 0.700 fine in gold from 3 tons of ore taken from an open-cut and treated in a 2-ton Gibson mill.

Kerber Creek district (Bonanza).—The Rawley mine, operated under lease throughout 1938 by Rawley Mines, a limited partnership, produced 6,764 tons of silver-copper-lead-gold ore, most of which was shipped to the copper smelter at Garfield, Utah; part of the remainder was concentrated in a custom mill at Bonanza, and part was shipped to the Leadville smelter. The W. C. H. Milling Co. treated 1,000 tons of ore from mines in the Kerber Creek district in a flotation mill built near Bonanza in 1938. Some ore was shipped direct to the Leadville smelter from the Klondyke, Rosalee, Sunnyside, and Warwick mines.

SAN JUAN COUNTY

Animas district.—Operations of the Shenandoah-Dives Mining Co., a large, steady producer since 1928, were interrupted for 7 weeks in March and April 1938 by damage to the aerial tram connecting the mine and mill caused by a snowslide, but the expanded rate of ore production made possible through development work in the mine and an increase in the capacity of the mill enabled the company to handle more ore than in 1937 or any previous year, despite the interruption. Equipment added to the mill in 1938 included one eight-cell and one six-cell flotation machine and a thickener and conditioner. The daily capacity of the mill was 750 tons at the end of the year. The company ore treated totaled 211,293 tons and yielded 7,120 tons of concentrates containing 18,993 ounces of gold, 329,197 ounces of silver, 1,566,749 pounds of lead (wet assay), 1,556,980 pounds of copper (wet assay), and 1,025,647 pounds of zinc. During the first 10 months of 1938 the company made bulk lead concentrates and some zinc concentrates; during the remainder of the year it made four products—lead flotation concentrates, copper flotation concentrates, zinc flotation concentrates, and iron table concentrates. In addition to its own ore the company treated 7,072 tons of custom ore from other mines in San Juan County, comprising, in approximate order of tonnage supplied, the Champion, Old Green Mountain, Ridgeway dump, Mystery, North Star-Sultan, Ezra R, Silver Ledge, Coming Wonder, Little Fannie, Bandora, Robert Bonner, and Snowslide. Some of the operators that shipped ore to the Shenandoah-Dives mill also shipped ore of smelting grade direct to the Leadville smelter. A few cars of ore were shipped to smelters from other mines in the district, including the Mexican group, Peerless, and St. Paul. A lessee at the Mable mine in the Copper Bell group treated 190 tons of gold-silver ore by amalgamation in a 10-ton mill at the mine. A 15-ton pilot mill erected at the Kankakee group was operated for a few weeks to test the ore. The American Smelting & Refining Co. continued development of the Silver Lake group through the 3,000-foot crosscut from the main haulage adit of the Mayflower group. Sluicing at the Depression placer claim 6 miles northwest of Silverton and at another placer in Red Canyon produced several ounces of placer gold.

Eureka district.—The Sunnyside Mining & Milling Co., which reopened the Sunnyside mine in 1937 and began production September 1, continued operations to June 30, 1938, when the mine was closed and remained idle to the end of the year; it was, however, the largest producer of lead and zinc in the State in 1938 and an important producer of gold, silver, and copper. The ore was transported from the mine over a 3½-mile aerial tram to the company 1,000-ton selective flotation mill at Eureka for treatment. The products of the mill were zinc concentrates (carrying also lead, copper, silver, and gold) shipped to the zinc smelter at Amarillo, Tex., and lead concentrates and iron concentrates (both carrying gold, silver, copper, and zinc) shipped to the Leadville smelter. In the latter part of the year the company did some work on a proposed 16,000-foot development and transportation adit to reach from the mine workings to the mill but suspended all activity at the property early in 1939. High-grade gold-silver-lead ore was shipped from the Brooklyn group to the Leadville smelter. Lessees at the Robert Bonner group shipped 38 tons of ore to the Shenandoah-Dives mill. Development work was continued at the Sandiago-Golden Fleece-Scotia group.

Ice Lake Basin district.—The Blanco Mining Co. drove 148 feet of drifts at the Bandora group from June 24 to November 5, 1938, and shipped 36 tons of ore to the Shenandoah-Dives mill and 137 tons to the Leadville smelter.

SAN MIGUEL COUNTY

Iron Springs district (Ophir).—The Butterfly Consolidated Mines, Inc., operated its group of mines and 100-ton gravity- and flotation-concentration mill continuously in 1938. The mill treated 16,000 tons of ore which yielded 2,002 tons of combined table and flotation concentrates containing 1,066 ounces of gold, 139,783 ounces of silver, 339,764 pounds of lead (wet assay), 74,854 pounds of copper (wet assay), 40,853 pounds of zinc, and 1,075,812 pounds of iron. The concentrates were shipped to the Midvale (Utah) smelter. The company drove 1,000 feet of development drifts and tunnels during the year and discovered a new body of silver-lead ore in a heretofore undeveloped vein. Several cars of smelting ore were shipped from the Carbonero and Hattie mines. Lessees treated approximately

50 tons of old tailings from the Suffolk millsite in a small amalgamation-gravity concentration mill erected to test the material. A little ore was shipped from other properties in the Iron Springs district, and some gold was recovered by amalgamation at the Gold Bar lode group and by placer methods at the Waterfall placer.

Lower San Miguel district (Sawpit, Vanadium).—Placer miners sluicing along San Miguel River and its tributaries produced some gold in 1938.

Mount Wilson district.—Individuals working the Special Session, Polar, Lakeview, and Silver Pick groups during the summer of 1938 shipped small lots of high-grade gold ore to smelters.

Upper San Miguel district.—Veta Mines, Inc., maintained production from the Smuggler Union mine at a higher rate in 1938 than in 1937 and continued to be the largest producer in San Miguel County. Part of the ore produced in 1938 came from above the Pennsylvania Tunnel or fifteenth level, the former lowest workings, and part from the new 1,600-foot level. Additional productive ground was opened as the company carried exploration to greater depth, reaching the Telluride Conglomerate formation at the 1,700-foot level. The company made many surface improvements to effect economies in the handling and treatment of ore, including the construction of a new aerial tram rerouting ore transportation and the transfer of milling facilities to the large steel and concrete building adjoining the old plant. The yield from 68,777 tons of ore treated by amalgamation and flotation concentration and 109 tons shipped crude to smelters was 12,788 ounces of gold, 227,684 ounces of silver, and 1,552,003 pounds of lead (gross in concentrates and smelting ore). Alta Mines, Inc., continued developing the Alta-St. Louis group and mined and treated a daily average of approximately 100 tons of ore throughout the year, except during short interruptions necessary for repairing or altering equipment. A lessee treated tailings on the Gold Run dump by gravity concentration for 80 days in 1938 and shipped gold-silver-lead-copper concentrates to the Leadville smelter. Lessees at the Tomboy group cleaned out and retimbered some of the caved workings on the Montana claim. They shipped a car of smelting ore and 21 tons of concentrates produced with jigs and tables from 1,000 tons of ore cleaned up on the surface. The equipment was dismantled later. A lessee worked 2 months on the Juan millsite in Telluride, treating old tailings with a screen and table. Some ore was treated by amalgamation at the Laura, Savage, and other claims operated on a small scale. Individuals sluicing along San Miguel River recovered small quantities of placer gold. The American Smelting & Refining Co. did 623 feet of drifting at the Fairview group after May 1 under an option agreement that was relinquished December 12.

SUMMIT COUNTY

Breckenridge district.—The output from lode mines in the Breckenridge district in 1938 comprised chiefly gold and gold-silver-lead ores shipped crude to the Leadville smelter from the Bemrose-Bostwick (also produces placer gold), Blue Flag, Fredonia, and Jumbo properties and zinc-lead-gold-silver ore shipped from the Royal Tiger property to the custom concentrator at Midvale, Utah. The Continental Dredging Co. operated its floating connected-bucket dredge on Blue

River, which has been the chief producer of gold in Summit County since 1932, from January 1 to April 13, 1938, when the company ceased operations. The dredge (equipped with 88 buckets, each of 7½ cubic feet capacity) was then dismantled, and the machinery was moved to Beaver Creek in Park County where it was used by the Timberline Dredging Co. in the construction of another dredge. The Bemrose-Bostwick and Louis D placers, each worked with a steam shovel and specially constructed sluice, were among the other principal producers of placer gold in the district. The Beaverhead, High Bar, John Jay, Pittsburg, and many other placers on Blue River, Farncomb Hill, and French Gulch were worked with sluices and hydraulic giants by individuals.

Montezuma district.—The Florado Mining Co., operating from March to July 1938, drove 300 feet of development crosscuts, drifts, and raises at the Florado-Sts. John group and erected a 100-ton flotation mill. During the period the company treated 2,100 tons (wet weight) of silver-lead ore; the concentrates were shipped to the Leadville smelter. Zinc-lead-silver ore from the Wauneita claim was shipped to the custom concentrator at Midvale, Utah. The ore produced at other mines in the Montezuma district in 1938 was shipped to the Leadville smelter. Producing mines included the Bullion group, Hall, New York, Ruby Silver, and Silver King claims.

Ten Mile (Kokomo, Robinson) district.—The Gold Crest Mining Co. shipped 80 tons of sorted gold-silver ore from the Gold Crest mine, operated 175 days in 1938, to the Leadville smelter. Lead-silver ore sold to the smelter from another property, a small lot of silver-gold ore shipped by lessees at the Washington group, and a small lot of placer gold recovered at the Lucky Penny placer comprised the remainder of the output from the Ten Mile district during the year.

Wilkinson district.—Walter McDaniel worked his Big Four claim (opened July 23, 1937, on Green Mountain) during part of 1938 and shipped 196 tons of silver-lead-gold-[zinc] ore to the Leadville smelter. A few truckloads of gold-silver-lead ore were shipped to smelters from the King Solomon and Fish Tunnel groups.

TELLER COUNTY

CRIPPLE CREEK DISTRICT

The Cripple Creek district produced, in terms of recovered metal, 145,215 fine ounces of gold in 1938 compared with 145,071 ounces in 1937. The bulk of the gold was recovered in the form of bullion at the Golden Cycle mill at Colorado Springs, El Paso County. As the mill also treats ores from other Colorado mining districts, its operations are reviewed under El Paso County. Cripple Creek ores shipped to the mill in 1938 totaled 480,105 tons and comprised all the district output except that from the Iron Clad group treated by cyanide leaching at the mine and part of the production from the Cameron group treated in a new flotation mill on the property. The ore shipped generally contains gold as the only commercial metal, but some silver ore has been shipped from two or three veins in the district; a comparatively small quantity of silver is recovered annually in bullion produced from the gold ores.

MINES REVIEW

The three largest producers of gold in the Cripple Creek district and in the State in 1938 were the United Gold Mines Co., an operating and holding company for property scattered throughout the district; the Cresson Consolidated Gold Mining & Milling Co., operating the Cresson, Dante, and Gold Sovereign mines; and the Golden Cycle-Ajax operations, working the Ajax-Granite group.

The annual report of the United Gold Mines Co. for the year ended December 31, 1938 (dated February 15, 1939), includes a report of the mine superintendent, which gives the following details on operations at individual mines:

Bonanza.—On the 22d level a low-grade body has been opened up on the X-10-U-8 vein. The grab samples run between 0.20-0.25 ounce. No stoping has been done on this to date. 270 feet of development work have been done on the 22d level.

On the 23d level the X-10-U-8 vein has been drifted on for 150 feet with no values encountered.

Deadwood.—The Gold Bullion Mines, Inc., lessees on the Deadwood, have produced a large tonnage of much better than average grade ore during the year and have also accomplished about 800 feet of development work on the first, second, and third levels. At the present time they are working three different ore shoots. One ore shoot on Trachyte ground has recently produced a carload of screenings which settled at 4.38 ounces. Prospects for this property during the coming year are very bright.

Findlay-Shurtloff.—The Golden Conqueror Mines, Inc., lessees on this property, has been very active during the past year, having accomplished 1,480 feet of drifting, 190 feet of raising, and 8 feet of winzing. They have also cleaned 80 feet of drifts on the 1,000 level of the Shurtloff and repaired 990 feet in the Manway side of the Shurtloff shaft. During the first 11 months of the year they have produced 10,423 tons of ore with a gross value of $107,488.67, and an average value of $10.31 per ton.

Hull City.—Operations on the Hull City were recently started by the United Gold Mines Co., and three sets of lessees operating on the split-check system have all discovered some ore, and we feel very hopeful that the mine will soon be on a paying basis.

Isabella.—This entire property has been leased to Hoy & Todd and associates and is the objective of a tunnel recently started on the 20th level of the Vindicator shaft. This tunnel will be 4,700 feet long; of this distance, approximately 1,300 feet has already been driven, but at the present time work on the tunnel has been suspended due to reorganization of the company. They expect to resume operations about January 10, 1939. A number of sets of sublessees are working on the surface and are producing some ore.

Mountain Beauty.—This entire property is leased to the Orpha May Leasing Co., and is being worked from the 13th level of the Orpha May shaft. They are driving a drift into Mountain Beauty ground and have discovered a small ore shoot and have shipped a few carloads of medium-grade ore.

Patti Rosa-Hardwood-Little Joe.—This entire property consists of about 15 acres and during the past year has been operated by the Tennessee Mines, Inc. This company has accomplished 1,193 feet of drifting and 450 feet of raising. It has mined 83,683 cubic feet of ore from the stopes and has shipped 91 railroad cars from the Hardwood, 6 cars from the Patti Rosa, and 9 cars from the Little Joe. This has all been medium-grade ore.

Portland.—The Portland Group has made a moderate but steady production through 1938, and the prospect for a continuation at the same rate in 1939 is good.

Portland No. 1, Portland No. 2, and the Last Dollar shafts have been operated by the company, with an average of 10 sets of lessees at No. 1, 6 sets of lessees at No. 2, and 10 sets of lessees at the Last Dollar.

No work has been done by the company underground except necessary repair work. All other mining has been done by lessees. A considerable amount of development was accomplished by lessees, some of it with assistance from the company. A fair amount of ore was developed by this work, and this has enabled the mine to maintain production.

The more notable discoveries include the ore shoot on the Bobtail vein, above 1,600 level, Portland No. 1; a new ore shoot on the Wisconsin vein, 1,300 Last Dollar, and the uncovering of some new ore bodies adjoining old stopes on the Wisconsin and 1,218 veins of the Last Dollar.

In addition to the company operated shafts, various other portions of the Portland Group have been operated by lessees on a royalty basis. Among these are the Independence, Colorado City, Portland No. 3, and several shallow shafts on Battle Mountain. These have contributed substantially to the total production.

The water in Portland No. 2 workings is receding very slowly, because of drainage from Ajax or Cresson pumping, and eventually another level (2,400) may be accessible.

Rose Nicol-Trail-Last Effort.—The Rose Nicol has produced a good grade of ore during the past year. Most of the company production has come from 900 and 1,000 through the Rose Nicol shaft, and from 1,700 of the Cresson. Production from 1,400 Cresson was stopped July 1.

A large low-grade deposit has been developed below 1,000 from the Berger winze, and at the present we are cutting out in the winze so that we will be able to start drifting on the Trail vein towards the shaft. Also a cross-cut is being driven from 1,700 of the Cresson to cut the Trail vein at greater depth.

On July 1 the mine was opened to lessees from 1,000 to surface, with the exception of a few blocks withheld by the company. The lessees have been heavy producers, with most of the ore coming from the 300 and 1,000 levels.

Theresa-Anna J.-Tateman-Logan Tract-Gold Knob.—Fourteen sets of split-check lessees are operating on the Theresa; of these lessees two sets are producing a good grade of ore, the other sets are all producing from medium- to low-grade ore. During the past year the Theresa shaft has been repaired and retimbered from surface to the 10th level.

Hansen & Co., working through the 8th level of the Theresa shaft, has drifted 500 feet on the contact between the granite and breccia on the Logan Tract. We consider this one of the most important developments in the Cripple Creek district.

The Tateman shaft is operated on a royalty lease by Lee Baker & Co., and just recently they have started to produce a small tonnage of better than average grade ore.

The Anna J. shaft is under lease to the Anna J. Leasing Co., and during the past year they have produced a fair tonnage of medium-grade ore.

Vindicator.—The Vindicator has 25 sets of lessees. Most of these lessees are producing medium- or low-grade ore, but two sets are producing a good grade of ore. The Vindicator accomplished more development work during 1938 than it has for the last several years. No work with the exception of the Cameron Tunnel drive is being done below 1,800.

Wild Horse.—The old Wild Horse shaft is leased to Judge Dickerson and associates and is being managed by F. G. Blackwood. The new or Gleason shaft has just recently been leased to Saddler and associates, and operations will be started about the first of the year.

W. P. H. Group.—The lower part of the W. P. H. has been under lease to The Doyle Diamond Drilling Co., and while no work was actually done on W. P. H. ground, development was carried on very close to the W. P. H. on Jerry Johnson ground, which could have easily been of great value to the W. P. H. This area has had very little development at depth. The operation was not a success, however, and has been discontinued.

The upper levels of the W. P. H. have been under lease to Jerry Johnson Gold, Inc. A small amount of work has been done by sublessee on this ground, working from the Jerry Johnson shaft, with a small production being made.

Production of company ore by United Gold Mines Co. in 1938

Mine	Net tons	Gross value	Company ore cash receipts	Average gross value per ton	Number of cars shipped
Vindicator	3,026	$11,161.97	$2,836.07	$3.69	99
Rose Nicol	4,621	66,284.95	43,004.30	14.35	121
Portland	281	1,769.55	522.67	6.29	8
	7,928	79,216.47	46,363.04	9.99	228

Production of lessee ore of United Gold Mines Co. in 1938

Group	Net tons	Gross value	Royalties received	Lessees' receipts	Average gross value per ton	Number of cars
Vindicator	27,740	$289,862.70	$81,463.73	$97,119.13	$10.45	859
Rose Nicol	8,507	76,064.74	13,559.01	26,540.55	8.94	264
Theresa	9,279	124,425.11	41,988.38	39,044.27	13.41	304
W. P. H. group	1,297	5,740.23	298.04	1,513.75	4.43	33
Deadwood group	20,810	228,417.55	18,450.84	107,128.65	10.98	625
Londonderry group	5,286	55,040.60	4,972.08	23,727.03	10.41	188
Hardwood group	4,751	56,398.21	5,107.81	26,684.01	11.87	124
Empire group	1,524	14,922.07	391.74	6,498.84	9.79	54
Portland	21,470	231,895.92	51,206.05	81,144.72	10.80	748
Last Dollar	12,748	120,859.80	37,966.15	35,061.93	9.48	408
Hull City	240	1,399.15	303.76	275.76	5.83	8
	113,652	1,205,026.08	255,707.59	444,738.64	10.60	3,615

Production of properties of United Gold Mines Co. before and after organization of the company (May 15, 1902) to Dec. 31, 1938

	Net tons	Gross value
Ore mined before consolidation	26,310	$456,806.19
Production under operation of United Gold Mines Co	1,716,591	18,656,295.99
Total to Dec. 31, 1938	1,742,901	19,113,102.18

The annual report of the Cresson Consolidated Gold Mining & Milling Co. for the 12 months ended December 31, 1938 (dated February 1, 1939), says—

During the 12 months 63,533 dry tons of ore were shipped on company account, of a gross value of $466,821.89, averaging $7.35 per ton. The returns, less transportation and treatment of $220,775.30, were $246,046.59; giving the ore a net value of $3.87 per ton.

The company received as additional income the sum of $2,878.56 from interest and miscellaneous income. Net royalty of $239,547.29 on 68,890 tons lessee ore made a total of $488,472.44, with total expenses of $358,343.86, resulting in a net gain from operations of $130,128.58.

Development

	Feet	Feet
Drifts and crosscuts:		
Company	6,069	
Lessees	1,459	
		7,528
Raises and winzes:		
Company	582	
Lessees	1,220	
		1,802
		9,330

The 18th level, which is 125 feet below the Roosevelt Drainage Tunnel, is at the present time producing the greater part of the company's tonnage. The ore from this level is low-grade, but the ore body is large and cheaply mined. This level should continue to produce a good tonnage throughout the year 1939.

A storage-battery locomotive has been installed and other improvements made in order to cut our haulage cost as much as possible.

Company work is being carried on from the 11th level down, and some ore is being produced on nearly every level. All workings have been maintained and kept open in order that they are accessible to any further operations.

Development work has been continued as in past years. During the past year, two new bodies of ore were opened on the 15th and 16th levels. Mining has not been started on either of these, so no estimate can be made on these ore bodies.

Twenty-six sets of split-check lessees are working through the Cresson shaft, most of whom are producing some ore.

The ore produced by both company and lessees has kept the hoisting plant running to full capacity throughout the year.

The Dante and Gold Sovereign shafts are operated by F. G. Blackwood, under a royalty lease. Both have made a good production during the year.

No attempt has been made to lower the water beyond the 18th level. Some unwatering plan should be made in the near future in order to prospect the ground below.

Various taxes, such as payroll and others, are showing an increase every year and now account for a considerable part of the total mining costs. However, during the past year, our total mining costs decreased 21 cents per ton over the previous year.

For the past 5 years, we have attempted to carry on a safety campaign in order to cut down accidents. This has resulted in a new rate set-up for the Cresson mine of $5.37 per $100.00 of payroll, against $6.81 for previous years. This will result in a substantial saving for the year 1939.

The average cost per ton shipped by company and the lessees during 1938 was $2.731 on a total of 132,423 tons.

Federal taxes	$0.060
State income taxes	.020
State and county taxes	.080
Capital stock tax	.010
Social-security tax	.028
Unemployment tax	.046
Compensation insurance	.100
Insurance	.006
Salaries of officers and directors	.040
Colorado Springs office	.030
Mining operations	2.261
Pumping	.040
General expense	.010

Production of Cresson Consolidated Gold Mining & Milling Co., 1903 to Dec. 31, 1938

Period	Dry short tons	Gross value	Freight and treatment	Net value
1903 to Dec. 31, 1937	2,587,807	$40,127,179.24	$12,783,552.28	$27,343,626.96
1938:				
Company ore	63,533	466,821.89	220,775.30	246,046.59
Lessee ore	68,890	808,869.87	315,082.25	493,787.62
1903 to Dec. 31, 1938	2,720,230	41,402,871.00	13,319,409.83	28,083,461.17

Period	Royalties received by company	Amount paid lessees	Average gross value per ton	Average net value per ton	Dividends
1903 to Dec. 31, 1937			$15.51	$10.57	$13,088,872.50
1938:					
Company ore			7.35	3.87	97,600.00
Lessee ore	$239,547.29	$254,240.33	11.74	7.17	
1903 to Dec. 31, 1938			15.22	10.32	[1] 13,186,472.50

[1] Represents 31.85 percent of gross value and 46.95 percent of net value.

The annual report of the Golden Cycle Corporation, dated February 15, 1939, for the calendar year ended December 31, 1938, contains the following paragraphs regarding the corporation's mining operations in the Cripple Creek district:

The Ajax shipped 53,040 tons with a gross value of $874,777.58, the freight and treatment amounting to $301,976.55. Since the Golden Cycle Corporation purchased the Ajax in August 1935, it has produced 155,697 tons with a gross value of $2,605,450.01, the freight and treatment charges amounting to $886,263.10.

Mining expenses for the year have been very high, due largely to the amount of water encountered in the new development work, resulting in a loss for the year of $66,502.22; however, the last 4 months of the year showed a profit, and it is hoped the year of 1939 will show an operating profit. 9,261 feet of drifts, cross-cuts, and raises were driven during the year.

Ore was opened on the New Market vein system on both the 2,400-foot and 2,600-foot levels, and the drifts are being pushed on this ore on both levels. On the 2,300-foot level a new ore body was encountered on the Bob Tail vein. This has very good possibilities both on the 2,400-foot and 2,600-foot levels. New development on the 2,600-foot level was badly hampered on account of water conditions, and all new work done on 2,600-foot was very costly in comparison to work above in the dry.

Every effort has been made to reduce operating expenses on the Ajax mine. A new washing and sorting plant is now under construction that will make a very good saving on the cost of ore sorting. This plant will be in operation about March 1, 1939.

Direct pumping costs on the Ajax property alone, not including the many extra costs due to working in heavy flows of water, were $83,399.35 for the year. This shows very definitely the necessity of a new drainage tunnel or central pumping plant that will drain the water to a greater depth than any property in the district is now working, if a supply of ore for the mill is to be maintained in future years. It is impossible for the Cresson, Ajax, or Vindicator mines to go deeper than they are now working, handle the water they will encounter, and operate at a profit.

Within the next few weeks estimates on the cost of a new drainage tunnel some 900 feet deeper than the present tunnel will be prepared for your consideration. Surveys for such a tunnel are now being carried on.[3]

The Anchoria Leland mine shipped 7,980 tons of ore with a gross value of $86,955.03. Net profit before depletion was $16,092.44 for the year of 1938. The Blue Bird lease results were disappointing, as no ore that could be worked at a profit was found. Work was discontinued on this property and the lease surrendered.

Companies and individuals leasing mines on the Stratton Estate together produced 25,898 tons of ore in 1938, which brought a net return of $159,856 after freight and treatment charges are deducted. The principal producing mines, in approximate order of metal output, were the Logan, Block 107, Orpha May, American Eagles, and Geneva; the other producers comprised the Abe Lincoln, Blocks 47, 98, 192, and 219, Callie, Favorite, Longfellow, Los Angeles, Pikes Peak, Specimen, Matoa, Sacramento, and War Eagle. The total development work done at all mines on the Stratton Estate in 1938 was 8,470 feet.

The Free Coinage group continued to be an important producer in 1938. Part of the property was worked by Golden Conqueror Mines, Inc., and Gold Bullion Mines, Inc., in combination with leases on the United Gold Mines property, and part was operated by other lessees. The Lark Mining Co. was a steady shipper from the Queen and Forest Queen groups, operated under lease. The New Gold Dollar Mining Co. property was operated for the first 9 months of 1938 by the Trio Gold Mining Co. under a lease, and for the remainder of the year by the New Gold Dollar Mining Co., owner. The Elkton, Doctor Jack Pot, Empire Lee, Acacia, Jerry Johnson, and Irving Howbert (Ethel Louise) groups were operated continuously. Gold Producers, Inc., worked the Victor mine on the Smith Moffat property under lease and the company-owned El Paso group. The Queen Bess Mining Co. shipped considerable ore from the Black Belle group. The Tenderfoot Mining Co. continued developing the Mollie Kath-

[3] Driving of the tunnel was authorized by the Golden Cycle Corporation in March 1939.

leen, Sangre de Cristo, and other groups on Tenderfoot Hill and shipped some ore. Cameron Mines, Inc., erected a 100-ton flotation mill at the Cameron shaft to treat low-grade sulfide ores from the Cameron and Pinnacle groups. The mill was run most of November and December, but not at capacity. The concentrates made were shipped to the Leadville smelter. The exploration and drainage tunnel begun by Cameron Mines, Inc., in 1937 to reach from the 2,000-foot level of the Vindicator shaft to the Isabella shaft had been driven approximately 1,000 feet by the end of 1938 and opened some ore on property of the United Gold Mines Co. Ore mined by the glory-hole system at the Iron Clad group was treated by cyanide leaching at the mine. During the year the Dooley Leasing Co. completed the purchase of the Rittenhouse group and shipped a substantial quantity of ore. Some of the other producing mines and dumps in the Cripple Creek district in 1938 were the Adney, Atlas (Midget-Bonanza King), Buckeye, Delmonico, Dolly Varden, Economic dump, Friday, Golden Swan group, Hamlet Dexter, Hiawatha, Index, Joe Dandy, Le Clair (Mary McKinney), Mary Nevin, Old Gold, Prince Albert, Rainbow, Ramona, Santa Rita Extension, School Section, Sheriff, and Strong.

Placer gold and high-grade specimen ore from the district, sold to assayers, refiners, and the Denver Mint, yielded 61 fine ounces of gold.

159434—39——21

GOLD, SILVER, COPPER, LEAD, AND ZINC IN THE EASTERN AND CENTRAL STATES

(MINE REPORT)

By J. P. Dunlop and H. M. Meyer

SUMMARY OUTLINE

The most significant features of mining and milling in the Eastern States in 1938 were the large increase in production of gold in South Carolina, and the relatively small decrease in production of zinc compared with the large decrease in zinc reported in the Central and Western States. The dominating event in the Central States, aside from the great decline in output of lead and zinc, was the acquisition of all mines, leases, mills, power plant, and other equipment of the Commerce Mining & Royalty Co. in Oklahoma and Kansas by the Eagle-Picher Mining & Smelting Co. The output of silver, copper, and zinc from mines in the Eastern States decreased in 1938, but silver production in the Central States increased. No gold was reported produced by any mine in the Central States; the output of gold from mines in the Eastern States increased 9,247 ounces (owing mainly to an increase of 9,198 ounces in South Carolina), notwithstanding a decrease of 2,419 ounces in Alabama.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in the Eastern and Central States in 1938, 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	300	41	$1,435	4	$3							$1,438
Georgia	841	872	30,520	71	46	70	$7					30,573
Maryland	1,701	855	29,925	24	16							29,941
New Jersey	528,595									85,839	[1] $10,891,683	[1] 10,891,683
New York	385,600			37,200	24,048			(2)	(2)	29,896	2,870,016	[3] 2,894,064
North Carolina	26,157	1,878	65,730	5,500	3,556	(4)	(4)	4	$368			[5] 69,654
Pennsylvania	(6)	1,422	49,770	9,360	6,051	(4)	(4)					[5] 55,821
South Carolina	59,930	11,681	408,835	3,951	2,554	(4)	(4)					[5] 411,389
Tennessee	1,507,320	236	8,260	38,333	24,781	[4] 21,079,090	[4] 2,065,751	[2] 7,896	[2] 726,432	[7] 56,766	[7] 5,449,536	[8] 8,274,760
Virginia	649,436	2,943	103,005	502	325	(4)	(4)	(2)	(2)	(7)	(7)	[9] 103,330
	[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
Total, 1937	[10] 3,407,883	10,681	373,832	106,873	82,667	24,444,000	2,957,725	5,539	653,602	189,353	24,894,159	28,961,985
Central States:												
Arkansas	(11)							7	644	152	14,592	15,236
Illinois	(11)			576	372			175	16,100			16,472
Kansas	3,751,300							15,239	1,401,988	73,024	7,010,304	8,412,292
Kentucky	(11)							101	9,292	322	30,912	40,204
Michigan	3,757,705			93,634	60,531	93,486,000	9,161,628					9,222,159
Missouri	4,148,000			292,000	188,768			122,027	11,226,484	10,226	981,696	12,396,948
Oklahoma	7,321,400							21,004	1,932,368	112,924	10,840,704	12,773,072
Wisconsin	58,700							320	29,440	2,073	199,008	228,448
	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
Total, 1937	26,516,112	51	1,800	206,041	159,374	95,466,000	11,551,386	204,885	24,176,430	244,045	31,725,850	67,614,840

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, Pennsylvania, South Carolina, and Virginia 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 pyritiferous magnetite, 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, Pennsylvania, South Carolina, and Virginia, lead from New York and Virginia, and zinc from Virginia.
9 Excludes value of copper, lead, and zinc, which is included under Tennessee.
10 Excludes pyritiferous magnetite 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 1938, by States

State	Number of mines		Gold (fine ounces)		Silver (fine ounces)	
	Lode	Placer	Lode [1]	Placer	Lode [1]	Placer
Alabama	1	2	30	11	3	1
Georgia	7	15	294	578	36	35
Maryland	2		855		24	
New Jersey	2					
New York	2				37,200	
North Carolina	14	6	1,861	17	5,500	
Pennsylvania	1		1,422		9,360	
South Carolina	10	2	11,677	4	3,950	1
Tennessee	7		236		38,333	
Virginia	5	1	2,886	57	500	2
	51	26	[1] 19,261	667	[1] 94,906	39
Total, 1937	39	40	[1] 10,049	632	[1] 106,843	30

[1] 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; pyritiferous magnetite 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.

1937: Dry and siliceous gold ores (60,542 tons) yielded 8,328 ounces of gold and 1,505 ounces of silver; copper ore (727,015 tons) yielded 373 ounces of gold and 53,491 ounces of silver; pyritiferous magnetite ore yielded 1,348 ounces of gold and 9,497 ounces of silver; zinc ore (1,679,334 tons) yielded no gold or silver; and zinc-lead ore (940,992 tons) yielded 42,350 ounces of silver.

Gold.—The production of gold in the Eastern States was 19,928 fine ounces in 1938, or 9,247 ounces more than in 1937. The output from siliceous ores increased from 8,328 ounces in 1937 to 17,441 ounces in 1938, that from placer mines from 632 to 667 ounces, and that from the refining of copper bullion from 1,721 to 1,797 ounces. Four gold-lode mines—two in South Carolina and one each in North Carolina and Virginia—produced more than 77 percent of the total gold recovered in the Eastern States in 1938. More lode mines but fewer placers were operated in 1938 than in 1937, and only two placers yielded more than 100 ounces of gold in 1938. The estimated output of gold in the Southern Appalachian States from 1799 to 1938, inclusive, is recorded as 2,532,776 fine ounces valued at $53,103,245.

In 1938, 88,671 tons of siliceous ore (from mines in Alabama, Georgia, Maryland, North Carolina, South Carolina, and Virginia) were treated, of which 87,615 tons went to gold and silver mills. Gold concentrates (542 tons) shipped to smelters yielded 2,497 ounces of gold, whereas bullion from gold milling plants yielded 13,894 ounces. Ore amalgamated (11,621 tons) yielded in bullion 1,633 ounces of gold and ore cyanided (75,994 tons) yielded 12,261 ounces. Only 1,056 tons of dry and siliceous ore were shipped crude to smelters; it yielded 1,050 ounces of gold.

Copper concentrates shipped to smelters yielded 1,632 ounces.

No mines in the Central States produced gold in 1938.

Silver.—Of the silver (94,945 fine ounces) produced in 1938 in the Eastern States, 39 ounces came from placer bullion, 3,709 ounces from bullion recovered at gold and silver mills, 82,048 ounces from concentrates smelted, and 9,149 ounces from ore shipped crude to smelters. Siliceous ores yielded 4,813 ounces of the silver; zinc-lead ores from New York, North Carolina, and Tennessee 38,263; copper ore 42,470; and copper concentrates recovered by flotation from pyritiferous magnetite ore 9,360 ounces.

The production of silver in the Central States in 1938 was 386,210 ounces. The output of Illinois (576 ounces) came from galena concentrates recovered in milling fluorspar, that of Missouri (292,000 ounces) was derived from the refining of lead bullion, and that of Michigan (93,634 ounces) came from copper ore.

Copper.—The mine production of recoverable copper in the Eastern States was 21,079,160 pounds valued at $2,065,758 in 1938 compared with 24,444,000 pounds valued at $2,957,725 in 1937. The output from Tennessee was considerably less than in 1937 and that from Pennsylvania increased, but the Bureau of Mines is not at liberty to show the copper production of each State. Gold ore and concentrates shipped to smelters from Georgia, North Carolina, South Carolina, and Virginia yielded small quantities of copper, but most of the total was derived from copper ore mined in North Carolina and Tennessee and from copper concentrates recovered from Pennsylvania pyritiferous magnetite ore mined for its iron content. The output of copper from gold ore in 1938 was 16,570 pounds. Copper ore yielded about 0.0006 ounce of gold and 0.07 ounce of silver to the ton of crude ore. Copper concentrates from the magnetite ore contained about 22.5 percent copper and 0.11 ounce of gold and 1 ounce of silver to the ton.

The copper output of the Central States in 1938 came entirely from Michigan copper mines. The output of refined copper from Michigan decreased from 94,928,000 pounds in 1937 to 93,486,000 pounds in 1938, but the average recovery per ton of rock increased from 22.6 to 24.9 pounds.

Lead.—The recoverable lead produced from mines in the Eastern States in 1938 came from zinc-lead ores from the Austinville mine in Virginia, the Balmat mine in New York, the Embree mine in Tennessee, and the Silver Hill mine in North Carolina. Shipments of galena or lead carbonate concentrates totaled 12,018 tons and yielded 7,900 tons of lead, or 2,361 tons more than in 1937.

Lead recovered from shipments of lead ore and concentrates in the Central States decreased from 204,855 tons in 1937 to 158,873 tons in 1938 owing mainly to the decrease in shipments from southeastern Missouri, the largest lead-producing region in the United States, from 153,205 to 118,870 tons. Mines in the Tri-State or Joplin region shipped 51,751 tons of lead concentrates in 1938 compared with 65,765 tons in 1937.

Zinc.—The recoverable zinc in ore and concentrates shipped from mines in the Eastern States totaled 172,501 tons valued at $19,211,235 in 1938 compared with 189,353 tons valued at $24,894,159 in 1937. Mines in New Jersey yielded 85,839 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 decreased from 32,690 tons in 1937 to 29,896 tons in 1938; 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 1938 was 56,766 tons; there was an increase in the output of each State.

Zinc concentrates shipped from mines in the Central States had a recoverable zinc content of 198,721 tons in 1938 compared with 244,045 tons in 1937. Mines in the Tri-State region shipped ore and concentrates yielding 196,174 tons of zinc in 1938, Oklahoma contributing 58 percent and Kansas 37 percent. Stocks of sphalerite were negligible at the end of 1938. The recoverable zinc in shipments from Missouri mines decreased from 20,600 to 10,226 tons; in 1938 all the output came from southwestern Missouri, but in 1936 and 1937 small shipments of sphalerite were made from southeastern Missouri.

MINE PRODUCTION IN THE EASTERN STATES

Alabama.—The quantity of gold produced in Alabama from 1830 to 1938, inclusive, has totaled 49,450 fine ounces. The output in 1938 was only 41 ounces compared with 2,460 ounces in 1937. The Hog Mountain mine, which had the largest output of gold in the Appalachian States in 1937, was idle in 1938. Production in 1938 was from two placer mines, in Tallapoosa and Talladega Counties, and from the Gold Log lode mine and mill in Talladega County, operated for a short period by the Guy S. Amos Mining Co.

Georgia.—From 1830 to 1938, inclusive, Georgia is reported as having produced 868,537 fine ounces of gold. In 1938, 15 placers and 7 lode mines yielded 872 ounces of gold and 71 ounces of silver. Of the 578 ounces of placer gold produced, 111 ounces came from mines near Dahlonega and Auraria in Lumpkin County, 425 ounces from mines near Sautee, Helen, and Nacoochee in White County, and the remainder from mines in Dawson, Hall, Cherokee, and Paulding Counties. The largest producers of placer gold were the Ferey Gold Mining Co. and the Dixie Gravel Co., both in White County. Gold recovered from 841 tons of siliceous ore amounted to 294 ounces and came mainly from the Hamilton mine in McDuffie County, operated by W. T. Fluker. The 10-stamp amalgamation-concentration mill was in operation for about 6 months on ore taken from two shafts; development work totaled about 690 feet. Various properties at Dahlonega controlled by Dr. Craig R. Arnold were leased or under option, and some should be productive in 1939. The Ferey Gold Mining Co. at Nacoochee, White County, the largest producer of gold in Georgia in 1938, operated its mine steadily all year by means of a dragline, trommel screen, and sluice boxes. The Simmons prospect near Buford, Gwinnett County, was worked by A. W. Amphlett Gold Mines. The Dixie Gravel Co. had a good output from the Dukes Creek placer mine, which was worked 120 days using a hydraulic elevator. The Shelley mine in Gwinnett County was operated about 10 months by Gavin D. McKay and J. B. McKay, and a 20-ton amalgamation-concentration plant was built. Some ore was milled, and a car of crude ore was shipped to Carteret, N. J. The shaft at the Shelley mine is 80 feet deep, and there are 150 feet of drifts. The Big Joe mine in Hall County was operated by Elmore Bish, and the bullion that was shipped was recovered by amalgamation at a small pilot mill; about 370 feet of drifting were done in 1938. A. D. Greenfield reopened the old Hobbs mine in Paulding County and made a small output. Gold bullion was shipped to the mint by T. F. Christian, J. S. Speer, and J. R. McDonald from various small operations in Lumpkin and Dawson Counties. R. H. Stumann, of Canton, shipped bullion purchased at small mines or prospects in Cherokee County. The Big Bunker Hill Mining Co. did not ship any bullion in 1938 but made extensive tests on its property and installed equipment to handle the saprolite by means of draglines and a log washing plant.

Maryland.—The total gold production of Maryland to the end of 1938 is estimated at 6,031 fine ounces. Until 1936 no gold had been produced in Maryland for many years, but in 1935 the Maryland Mining Co. did some development work in Montgomery County and in 1936 was the third largest producer of gold from gold ore in the Eastern States; in 1937 and 1938 it ranked fifth. The mine was worked nearly all of 1938; it is equipped with a 200-foot three-compartment shaft, and ore is mined at the 150- and 200-foot levels. The bullion sent to the mint was 950 fine and contained very little silver. The property controlled covers about 250 acres and is said to show numerous veins of good ore. Prospecting was done by Kirk & McNamara at the old Harrison mine and other prospects about 2½ miles from the Maryland mine. Two shafts were being sunk in November 1938, and some open-cuts were made. In one of these open-cuts a stringer of rich ore was found and panned. It yielded more than 40 ounces of gold. The bullion, which was sent to the Philadelphia Mint, had a fineness of 983. It is unusual for gold bullion to run even 950 fine, although some of the Georgia mines yield bullion of about that fineness.

New Jersey (see also second table of this chapter, footnote 1).—The production of zinc ore in New Jersey in 1938 was 528,595 tons containing 85,839 tons of recoverable zinc as metal or in oxide. The producing properties were the Sterling and Mine Hill mines; these mines were operated about 250 days in 1938 and have a much larger potential output.

New York.—The quantity of zinc ore mined and treated in New York decreased from 112,478 tons in 1937 to 105,000 tons in 1938 and that of zinc-lead ore from 352,392 to 280,600 tons. The total concentrates shipped yielded 29,896 tons of zinc and more than 2,000 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 1,250-ton all-flotation concentration plant, and has an enclosed 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 550 tons. It is reported that the Universal Exploration Co. was doing some diamond drilling in St. Lawrence County in 1938.

North Carolina.—The gold output of North Carolina from 1799 to 1938, inclusive, is recorded as 1,154,677 fine ounces. The yield in 1938 was 1,878 ounces—1,861 ounces from 14 lode mines and 17 ounces from 6 placers. The output of silver was 5,500 ounces, of which 387 ounces came from dry gold ores, 206 ounces from zinc-lead ore, and the remainder from copper ore. The Fontana copper mine was the largest producer of silver and the third largest producer of gold in North Carolina in 1938, although the assay content of gold and silver is low. The largest producer of gold in North Carolina was the Capps mine in Mecklenburg County. The meager output of placer gold came from small mines or prospects in Cabarrus, Guilford, Halifax, Stanly, and Union Counties. The North Carolina Exploration Co. shipped high-grade crude sulfide copper ore from the Fontana mine in Swain County to the Tennessee Copper Co. smelter at Copperhill, Tenn. About 77 percent of the gold output of North Carolina came from the Capps mine; the Capps mill, a 125-ton cyanide plant, is near Charlotte in Mecklenburg County. Custom ore from a few mines in North Carolina and from the Terry, Ross-Carroll, Spartan, and Dixon mines in South Carolina was milled also at the Capps plant; this mill had the second largest gold output in the Appalachian States in 1938. The Rudisil mine and 50-ton flotation plant at Charlotte were closed in March 1938 after 35 months of operation, during which time the reported output was $130,000. The Silver Hill mine in Davidson County, which has been idle many years, was reopened by T. A. M. Stevenson in August 1938. The ore mined is zinc-lead containing copper, gold, and silver. There are several shafts at the mine, one of which is an inclined shaft of 725 feet. One old shaft was cleaned out, and a new prospect shaft was sunk. The property is equipped with a 10-stamp mill and Deister slime tables. Only a small quantity of ore was treated; some lead concentrates were shipped to Carteret, N. J., but the zinc concentrates were held for further treatment. Several cars of crude ore from the Dixie Queen mine in Cabarrus County were shipped by J. A. Terry to Carteret, N. J.; the ore contained gold, silver, and copper. The Tribro mine in Halifax County was worked 60 days by Passavant Bros., and a small amalgamation plant was constructed; the ore was mined from an open-cut and yielded good recoveries of gold. Several hundred tons of ore were mined by W. L. Cotton from the Mumford, Stewart, and Carter mines near Albemarle in Stanly County. Other small producing lode mines were the Porter in Union County, the Halifax in Franklin County, and the Spoon in Randolph County.

Pennsylvania.—The Cornwall mine and mill in Lebanon County were operated steadily throughout 1938; the mine has an open-cut and three inclined shafts 1,300 feet deep. The ore is pyritiferous magnetite, and the tailings from the iron concentrates go to the 2,000-ton flotation plant; the copper concentrates, which contain about 22.5 percent copper and 0.11 ounce of gold and 1 ounce of silver to the ton, were shipped to the Nichols Copper Co. The Reynolds Metal Co. had an option to purchase the old Friedensville zinc properties in Lehigh County but allowed the option to lapse in 1938.

South Carolina.—From 1829 to 1938, inclusive, mines in South Carolina produced 268,413 fine ounces of gold. In 1938 the output from ten lode mines and two placers was 11,681 ounces, of which only 4 ounces came from placers. Gold milling plants recovered 10,552 ounces of gold and 3,252 ounces of silver, and crude ore and concentrates shipped to smelters yielded 1,125 ounces of gold and 698 ounces of silver. The old Haile mine in Lancaster County, with a reputed total production of more than $3,000,000 in gold, was worked throughout 1938. Its production and that of the Terry mine largely accounted for the notable increase in the gold output from South Carolina and from the Southern Appalachian States. The small output of placer gold came from the Brewer mine in Chesterfield County and the Smith mine in York County. The Dorothy mine in York County was operated by the Thirty-Five Mining Co. until April 1938, and some crude ore was shipped to Carteret, N. J.; after April the mine was operated by W. H. Small, and 3 cars of crude ore were shipped to the Tennessee Copper Co. at Copperhill, Tenn. Among the mines in South Carolina that shipped ore to the Capps mill at Charlotte, N. C., were the Dixon and Ross-Carroll in York County and the Terry and Spartan in Cherokee County. The Ross-Carroll mine was operated 9 months by W. E. Tummon by means of open pits and trenches. Other production included that from the old Hegeler mine in Lancaster County, on which 200 feet of drifts were run; a few ounces of gold recovered in sampling the McGill and the Eustis mines in Cherokee County, both worked by H. M. Armstrong; and that from the Quinn prospect in York County, operated by R. B. Summerford. Crude ore from the McGill, Eustis, and Quinn was shipped to Carteret, N. J. The Terry mine near Smyrna was worked by Southern Gold, Ltd., for 11 months; two vertical shafts, 135 and 175 feet deep, were used to mine the ore, which was shipped partly to the Capps mill and partly to Carteret, N. J. The crude ore contains a little copper and silver, and the quantity of gold recovered was large considering the fact that the shipments of ore totaled less than 2,800 tons.

Haile Gold Mines, Inc., operated its mines and countercurrent decantation cyanide plant throughout 1938 and late in December completed a new mill unit that increased the daily capacity of the plant to about 400 tons. All the ore, which is a mixture of quartz and pyrite, is mined by open-cut methods. A new ore body was stripped by draglines, and ore was mined from two pits. The mines and mill comprise one of the most efficiently operated units in the Southern States, and although the ore is of comparatively low grade the ample reserves and low costs of mining, combined with efficient milling, have made the operations profitable. Geophysical exploration in 1938 indicated about 20 anomalies, and 28 churn- and 25 diamond-drill holes were finished in 1938. Twelve of these drill holes are on Red Hill. Drilling is being continued on other areas. The history of the Haile mine and its development and operation by the present owners have been described by Brodt and Newton.[1]

Tennessee.—Mines in Tennessee produced 19,475 fine ounces of gold from 1831 to 1938, inclusive; almost the entire output since 1906 has come from copper ore, and copper bullion was the sole source of the 236 ounces produced in 1938. The quantity of silver recovered in 1938 was 37,476 ounces from copper ore and 857 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 1,600 tons from 1937 to 1938, but that of zinc increased about 475 tons.

The total output of copper from mines in Tennessee, North Carolina, South Carolina, Virginia, and Pennsylvania was 10,540 tons in 1938 compared with 12,219 tons in 1937; production increased in Pennsylvania, South Carolina, and Virginia. The total lead recovered from mines in New York, Tennessee, and Virginia was 7,896 tons in 1938 compared with 5,539 tons in 1937. The total zinc recovered from mines in Tennessee and Virginia was 56,766 tons in 1938 compared

[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.

with 55,255 tons in 1937; Virginia mines showed the larger increase. 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, 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.; a few carloads of ore were received from other States. Some 48.2-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 2,600-ton concentrating plant of the American Zinc Co. of Tennessee were operated steadily in 1938; 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 1938 than in 1937. 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 had been equipped with a differential-tension density cone that considerably increased the capacity of the plant. The Universal Exploration Co. worked steadily in 1938 at both the mine and 800-ton all-flotation mill, but the plant for treating zinc carbonate ore was idle throughout 1938. The average grade of the sphalerite shipped in 1938 was 64.765 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 about 250 tons. A log washing plant was used to treat the crude ore. About 1 carload of zinc carbonate ore was shipped in 1938 by C. A. Wilson, of Jefferson City. Both the Mascot and Universal properties obtained much lower electric-power rates in October 1938, thereby reducing operating costs considerably.

Virginia.—Mines in Virginia produced 166,193 fine ounces of gold from 1828 to 1938, inclusive, but only 7,076 ounces have been produced during the last 28 years. In 1938 the output of the State was 2,943 ounces of gold and 502 ounces of silver from five lode mines and one placer. Shipments of both lead and zinc concentrates increased, but the Bureau of Mines is not at liberty to publish figures for lead and zinc output as the Austinville mine of the Bertha Mineral Co. is the only producer of zinc-lead ore in Virginia. The mine and 2,000-ton concentration-flotation mill were operated steadily throughout 1938.

Most of the gold produced in Virginia in 1938 came from the Vaucluse mine near Wilderness, Orange County. This mine has a vertical shaft 325 feet deep, and 435 feet of drifts were run in 1938. The sulfide ore is treated at a 75-ton all-flotation plant, and the concentrates are shipped to Carteret, N. J. The mine was worked from January to November, and then some exploration work was done on placer ground. The Red Bank mine near Virgilina, Halifax County, was operated 216 days by Joseph Hamme; the property is equipped with a small amalgamation plant. The Bull Neck lode-gold mine near McLean, Fairfax County, was idle in 1938. The Booker mine near Dillwyn in Buckingham County, which is equipped with a small amalgamation-concentration plant, was operated most of the year; bullion was shipped to the Philadelphia Mint and concentrates to

Carteret, N. J. Some crude copper ore containing 15 percent copper and a little silver was shipped by the Nassog Co. from a prospect in Floyd County to Carteret, N. J. The placer-gold output of Virginia in 1938 came mainly from the Bertha and Edith mines in Goochland County, which were operated 5 months by means of a gasoline drag-line by H. H. Walton, of Pendletons.

MINE PRODUCTION IN THE CENTRAL STATES

Quantity and tenor of ores.—The only fair 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, 1936–38, by States

State [1]	1936		1937		1938	
	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	4,644,800	2.09	5,607,900	1.90	3,751,300	2.58
Michigan	3,225,600	1.49	4,197,881	1.13	3,757,705	1.24
Missouri	4,290,000	3.12	5,992,731	3.07	4,148,000	3.28
Oklahoma	9,085,600	1.84	10,432,000	1.77	7,321,400	1.71
Wisconsin	284,800	3.93	285,000	3.41	58,700	4.46
	21,530,800		26,515,512		19,037,105	

[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 year by year are found in Mineral Resources and Minerals Yearbook.

Of a total of 360,504 tons of blende concentrates produced in 1938 in the Tri-State region, 59,987 tons, or 54,283 tons less than in 1937, were derived from old tailings.

Mine production of lead and zinc in the Central States in 1938, by regions

Region	Lead[1]		Zinc[2]		Total value
	Short tons	Value	Short tons	Value	
Concentrates:					
Joplin or Tri-State	51,751	$2,682,767	361,526	$11,100,690	$13,783,457
Southeastern Missouri	163,500	9,040,593			9,040,593
Upper Mississippi Valley[3]	493	21,050	[4] 3,895	121,180	142,230
Kentucky-southern Illinois	490	14,700	789	12,263	26,963
Northern Arkansas	10	500	437	8,500	9,000
	216,244	11,759,610	366,647	11,242,633	23,002,243
Total, 1937	277,283	19,059,375	485,558	19,037,760	38,097,135
Metal:					
Joplin or Tri-State	39,400	3,624,800	196,174	18,832,704	22,457,504
Southeastern Missouri	118,870	10,936,040			10,936,040
Upper Mississippi Valley[3]	320	29,440	2,073	199,008	228,448
Kentucky-southern Illinois	276	25,392	322	30,912	56,304
Northern Arkansas	7	644	152	14,592	15,236
	158,873	14,616,316	198,721	19,077,216	33,693,532
Total, 1937	204,885	24,176,430	244,045	31,725,850	55,902,280

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 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

REVIEW BY STATES

Arkansas.—A total of 437 tons of zinc carbonate and mixed zinc carbonate and sulfide was shipped from about seven mines in Arkansas in 1938 compared with 777 tons shipped from Arkansas mines in 1937; the recoverable zinc in the concentrates in 1938 was 152 tons. None of the mines gave any data for 1937 or 1938 on their operations or shipments, but the smelters that purchased the concentrates gave the information. Shipments of zinc concentrates were made from the McIntosh mines and Silver Hollow, Monte Cristo, and Red Cloud mines in the Rush district; other shipments were made of small lots purchased from scrappers in Newton County. The only shipments of lead concentrates from Arkansas in 1938 were about 10 tons from the Ponca district, purchased by the Eagle-Picher Mining & Smelting Co.; the recoverable lead content was 7 tons.

Illinois.—No lead or zinc mines in Illinois were operated in 1938. Shipments of galena from fluorspar mines in southern Illinois in 1938 totaled 294 tons with an average lead content of 60.9 percent; 175 tons of lead and 576 fine ounces of silver were recovered from these shipments compared with 186 tons of lead and 887 ounces of silver in 1937. The Aluminum Ore Co. and the Hillside Fluor Spar Mines were the largest shippers. The Mahoning Mining Co. operated churn drills near Cave in Rock, Hardin County, and developed a body of fluorspar-zinc-lead ore which contains more zinc than is normally found with fluorspar. Two shafts were sunk, and flotation tests showed that the crude ore was amenable to treatment to recover lead concentrates, zinc concentrates, and fluorspar of good grade.[2] A mill under construction in 1938 is expected to be operated in 1939.

Kansas.—Shipments of galena concentrates from mines in Kansas totaled 19,909 tons with a recoverable lead content of 15,239 tons compared with 20,559 tons with a recoverable content of 16,008 tons

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.

in 1937. Shipments of sphalerite concentrates amounted to 133,546 tons with a recoverable zinc content of 73,024 tons in 1938 compared with 151,646 tons with a recoverable content of 80,300 tons in 1937. About 575,700 tons of Kansas crude ore were concentrated at mills in Oklahoma and yielded 45,204 tons of sphalerite concentrates and 6,217 tons of galena concentrates. In all, about 31 lead-zinc mines and 22 mills were operated in Kansas in 1938.

No output for 1938 was reported from the Lawton or Crestline camps, and little prospecting was done. Production in the Kansas part of the Waco area was mainly from tailings and from ore from the Acme mine treated by the B. H. & G. Mining Co. The old Acme mine was reopened early in 1938 and had a large output. The total output of the Waco area in 1938 was 103 tons of galena and 8,337 tons of sphalerite, of which properties in Kansas yielded 36 tons of galena and 5,772 tons of sphalerite. Some development work was done by the St. Louis Smelting & Refining Co. on its property at Waco, but the mines and 800-ton mill were idle. Operations at the Galena camp were confined to scrapping. Mines and mills near Baxter Springs shipped 4,184 tons of galena and 20,323 tons of sphalerite. The St. Louis Smelting & Refining Co. (mines and Ballard mill) was much the largest producer of both lead and zinc. Only a small quantity of old tailings was milled by the O. W. Bilharz Mining Co. Ore was mined and milled or shipped to custom mills from the Hocker, Robob, Wade, Iron Mountain, and Sunflower mines. Mines in the Blue Mound-Treece area shipped 15,659 tons of galena and 93,248 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, Silver Fox, and Northern. The Muncie mill of the Federal Mining & Smelting Co. resumed production in 1938. The larger producers in this area, other than those shipping to the Central mill, were: The Vinegar Hill Zinc Co. (Barr mine), Evans Wallower Zinc. Co. (No. 14), J. P. Dines Mining Co. (Blue Mound and Southern), American Zinc, Lead & Smelting Co. (Robinson), Commerce Mining & Royalty Co. (Wilber, Webber, and Chubb), the Cherokee mine, and the New Blue Mound mine. The four tailing mills in this area shipped 40 tons of galena and 13,782 tons of sphalerite; they were the Captain Milling Co., C. Y. Semple, Lewis Milling Co., and Youngman & Youse.

Mine shipments of lead and zinc in Kansas, 1934–38

Year	Lead concentrates [1]		Zinc concentrates		Metal content [2]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	8,734	$346,557	72,862	$2,010,505	6,805	$503,570	38,261	$3,290,446
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

[1] Includes lead carbonate from Galena in 1934: 100 tons containing 63 percent lead.
[2] 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, 1937–38

	1937		1938	
	Crude ore	Old tailings	Crude ore	Old tailings
Total ore and old tailings milled...short tons..	2,081,300	3,526,600	2,044,500	1,706,800
Total concentrates shipped:				
Galena...do....	20,449	110	19,869	40
Sphalerite...do....	120,233	31,413	116,213	17,333
Ratio of concentrates to ore, etc.:				
Lead...percent..	0.87	------------	0.97	------------
Zinc...do....	5.23	0.89	5.15	1.01
Metal content of ore, etc.:				
Lead...do....	.68	------------	.76	------------
Zinc...do....	3.15	.53	3.46	.61
Average lead content of galena concentrates...do....	79.6	55.0	78.0	60.6
Average zinc content of sphalerite concentrates..do....	60.3	58.3	60.8	60.0
Average value per ton:				
Galena concentrates...	$70.91	$44.04	$51.45	$40.00
Sphalerite concentrates...	42.64	42.80	30.60	33.22

Kentucky.—Seven mines in Kentucky shipped 218 tons of zinc carbonate, 571 tons of sphalerite, and 196 tons of lead carbonate in 1938. The zinc carbonate sold was shipped largely by Avery H. Reed of Marion and by C. F. Lester of Princeton, and the sphalerite was from the Eagle Fluor Spar Co. property. The bulk of the lead concentrates were shipped by Roberts & Frazer (Kentucky Fluor Spar Co.), the Klondike Fluorspar Corporation, and the Lafayette Fluorspar Co. The lead carbonate averaged about 52.6 percent lead and the sphalerite about 48 percent zinc. The recovered content of ore shipped was 101 tons of lead and 322 tons of zinc.

Michigan.—Copper production in many districts of the United States was considerably lower in 1938 than in 1937, but output in Michigan was relatively stationary during the 2 years. The Isle Royale Copper Co. resumed active operations in 1938; otherwise the producers were the same as in 1937—that is, Calumet and Hecla Consolidated Copper Co., Copper Range Co., and Quincy Mining Co. The decline in output at Calumet and Hecla in 1938 was counteracted by increased activity at the Copper Range and Quincy properties and by the production at Isle Royale. With resumption of treatment of tailings in 1935, the grade of ore treated in Michigan fell steadily until 1938, when the ratio of tailings to new ore declined; consequently the average grade of ore treated rose from 1.13 percent in 1937 to 1.24 percent in 1938. The 3,757,705 tons of rock and sands treated in 1938 yielded 93,486,000 pounds of copper, compared with 4,197,881 tons yielding 94,928,000 pounds in 1937.

The Peninsula Copper Co., organized by bondholders of the Seneca Copper Corporation, acquired the assets of the bankrupt Seneca company in May and optioned the property to Calumet and Hecla. This mine includes a large area adjacent to the openings in the Kearsarge lode at North Ahmeek, and, according to the Calumet and Hecla company, openings at Ahmeek indicate that copper mineralization on the Kearsarge lode extends to some degree at least into Peninsula territory. Results of the exploration work are somewhat encouraging.

The Isle Royale Copper Co. resumed shipment of rock to its mill in July. Mining is confined to Nos. 4 and 5 shafts where the bulk of the ore reserve is located. A description of operations at the Isle Royale mine was prepared by Eaton.[3]

The Quincy Mining Co., which reopened its mine in 1937, increased production in 1938. It was reported that the company was obtaining the highest yield of copper per ton of rock treated in many years (more than 34 pounds to the ton). Mining was proceeding on the 85th, 86th, and 87th levels of No. 6 shaft, which is opened to the 91st level.

Mine production of gold, silver, and copper in Michigan, 1934–38 [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")	Yield: Percent	Pounds	Yield (percent copper)	
1934	58.63	[5] 529	[6] 48,215,859	[6] 68.9	[6] 3.44	[6] 70,102,754	[6] 68.8	[6] [7] 700,055
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	[8] 4,197,881
1938		93,634	93,486,000	24.9	1.24	144,964,890	64.5	3,757,705

[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] According to Bureau of the Mint.
[6] No sands reported for 1934.
[7] Excludes 800 tons of ore amalgamated for recovery of gold and silver.
[8] Excludes 600 tons of siliceous ore.

Value of silver and copper produced in Michigan mines, 1934–38

Year	Silver	Copper: Total	Copper: Per ton of ore ("rock")	Total	Year	Silver	Copper: Total	Copper: Per ton of ore ("rock")	Total
1934	[1] $342	$3,857,269	$5.51	$3,857,611	1937	$19,689	$11,486,288	$2.74	$11,505,977
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					

[1] According to Bureau of the Mint.

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 1938 totaled 48,264,000 pounds at an average cost sold (excluding depreciation and depletion) of 7.37 cents a pound. The Lake Linden and Tamarack reclamation plants curtailed production throughout the year by treating sand below the average grade of reserves and operating at 60 percent of capacity for 5 months of the year. Together they recovered 16,619,000 pounds of copper at an average cost sold (excluding depreciation and depletion) of 6.86 cents a pound. In 1937 the mines produced 53,876,000 pounds at an average cost of 7.59 cents a pound and the reclamation plants 20,398,000 pounds at 6.63 cents. Benefits from the small decrease in costs

[3] Eaton, Lucien, Reopening and Rehabilitating the Isle Royale Copper Mine: Min. Cong. Jour., vol 24, No. 10, October 1938, pp. 39–43.

were more than wiped out by the lowering of the average price received from 14.11 cents a pound in 1937 to 10.03 cents in 1938. Exhaustion of the Conglomerate lode draws nearer with shafts Nos. 7 and 6 exhausted on September 30 and October 10, respectively, and exhaustion of No. 12 shaft expected during the summer of 1939.

Operations at the Calumet and Hecla reclamation plants at Lake Linden and Hubbell in 1938 and for the entire period of their operation

	1938	Since starting
Quantity treated ....short tons..	1, 934, 000	31, 098, 000
Assay headings ....percent..	0. 517	0. 666
Assay tailings ....do....	. 085	. 128
Refined copper produced ....pounds..	16, 619, 000	333, 943, 000
Refined copper produced per ton treated ....do....	8. 59	10. 74

Of the 1938 production 5,288,000 pounds were from table treatment following grinding, 8,921,000 pounds from leaching, and 2,410,000 pounds from flotation. At the Calumet mill at Lake Linden 461,551 tons of Conglomerate rock were stamped. At the Ahmeek mill 667,412 tons of Kearsarge amygdaloid rock from the Ahmeek mine, 5,271 tons from No. 4 Kearsarge, and 8,876 tons from the Peninsula Copper Co. area were stamped. The smelter received 52,321 tons of concentrates, smelted 38,529 tons, and produced 46,418,962 pounds of refined copper. Copper oxide totaling 1,176 tons was shipped to customers. Results of explorations in the Mass-Michigan area in Ontonagon County were generally unfavorable.

The mine production of copper by the Copper Range Co. was 18,010,937 pounds, and copper produced at the tailings recovery plant amounted to 55,954 pounds, making a total of 18,066,891 pounds of copper. Of the copper produced, 1,618,986 pounds were from the Globe mine and the remainder from the Champion mine. Ore reserves at the Champion mine were reported to be about the same at the end as 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 only 3 weeks in January owing to conditions in the copper industry and low metal prices. The plant is reported to be ready to resume operations on short notice. The average cost of production for the company was reduced from 11.45 cents a pound in 1937 to 9.50 cents in 1938, but as the average selling price fell from 12.375 to 9.80 cents there was a decline in the net realization per pound. Operations of the company for 5 years are shown in the following table.

Copper produced by the Champion mine of the Copper Range Co., 1934–38

Year	Rock stamped	Copper produced	Yield per ton	Cost per pound [1]	Price received
	Short tons	*Pounds*	*Pounds*	*Cents*	*Cents*
1934	241, 175	13, 929, 859	57. 76	8. 69	8. 55
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]	333, 190	18, 066, 891	54. 06	9. 50	9. 80

[1] Excludes depreciation and depletion.
[2] Excludes 133,594 tons of tailings treated.
[3] Yield from ore only.
[4] Includes Globe mine.

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, 1934–38

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
1934	846	$30,790	428	$11,829	12,691	$345,925	1,200	$17,437	913	$67,562	7,059	$607,074
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	821	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

[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, 1935–38

	1935	1936	1937	1938
Total ore and old tailings treated ....short tons..	[1] 554,300	[2] 871,200	[3] 980,100	[4] 479,600
Total concentrates in ore:				
Lead ....percent..	0.15	0.27	1.02	0.88
Zinc ....do....	2.60	3.95	5.82	4.07
Metal content of ore:				
Lead ....do....	.10	.20	.78	.67
Zinc ....do....	1.49	2.40	3.47	3.00
Average lead content of galena concentrates ....do....	73.7	77.0	79.0	77.0
Average lead content of lead carbonate concentrates ....do....	60.0	63.0	63.0	50.0
Average zinc content of sphalerite concentrates ....do....	59.4	61.1	60.7	58.5
Average zinc content of silicates and carbonates ....do....	38.0	40.1	40.5	44.4
Average value per ton:				
Galena concentrates	$40.00	$50.53	$66.00	$50.79
Lead carbonate concentrates	30.00	35.70	47.16	31.16
Sphalerite concentrates	28.57	32.20	43.30	30.26
Zinc silicates and carbonates	14.62	17.33	25.69	17.54

[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.

Mine production of lead and zinc in southeastern Missouri, 1934–38

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	121,781	$4,505,900			89,580	$6,628,920		
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		

[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, 1935–38

	1935	1936	1937	1938
Total lead ore....short tons..	3,082,300	3,418,800	5,012,631	3,668,400
Galena concentrates in ore....percent..	4.26	4.26	4.18	4.45
Zinc content of ore....do....	----------	----------	----------	----------
Average lead content of galena concentrates....do....	73.3	76.0	74.5	74.8
Average value per ton of galena concentrates....	$42.91	$50.00	$68.42	$55.29
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 $12,396,948 in 1938 compared with silver, copper, lead, and zinc valued at $21,482,555 in 1937. The silver in 1938 (292,000 ounces) was recovered from lead refining; lead ore yielded no copper. The quantity of recovered lead decreased from 157,631 tons in 1937 to 122,027 tons in 1938 and that of recoverable zinc from 20,600 to 10,226 tons.

Shipments of lead concentrates (of which only 104 tons in 1938 and 173 tons in 1937 were lead carbonate) from Missouri mines were 167,734 tons compared with 215,697 tons in 1937; of the total, 163,500 tons were shipped from mines in southeastern Missouri compared with 209,937 tons in 1937, and the recovered lead content in southeastern Missouri was 118,870 tons in 1938 and 153,205 tons in 1937. No sphalerite was shipped in 1938 from southeastern Missouri. Shipments of lead concentrates from southwestern Missouri mines in 1938 comprised 4,130 tons of galena and 104 tons of lead carbonate; most of the galena concentrates were from mines in the Spring City, Oronogo, and Diamond camps.

The total value given for all concentrates is based on actual receipts by the sellers and not on quoted prices. In 1938, as in 1937, the quoted price was that paid for medium quantities or carload lots; small lots brought less.

The quoted price for 80-percent galena concentrates for the first 4 weeks of 1938 was $55 a ton. Early in February it declined to $49.43 and in April to $49 where it was pegged for 8 weeks. At the end of May the price declined further to $42.14, which held for 4 weeks. Late in June the quotation advanced to $49.34 and on the first of July to $55.10, which held for 9 weeks. In September the price advanced to $57.98 where it remained about 10 weeks. The quotation dropped late in November to $56.64 and in the first week in December to $52.94. The price during the last 2 weeks of 1938 was $54.38.

The quoted price of coarse sphalerite concentrates in 1938 ranged from $27.50 to $33.50 a ton. The opening quotation was $31.50, and in the sixth week the price declined to $29.50, which held for 6 weeks. At the end of March the quotation was $28.50, and early in April it dropped to as low as $27.50 where it stayed until the end of June. Early in July the price advanced to $30 where it was steady for 12 weeks. There was an upward swing in September, quoted prices reaching $31.50 in September and $32.50 in October. The high price of 1938 ($33.50) was reached early in November. News of the reduced import duty on zinc promptly caused a decline to $31 and then to $29, the quoted price for the last 4 weeks of 1938.

No prices were quoted for zinc silicate or lead carbonate concentrates. Flat purchase rates for the year were $31.14 a ton for lead carbonate and $17.54 for zinc silicate concentrates. There was no great demand for zinc silicates in 1938, and the production was only 1,022 tons.

The foregoing quoted prices apply to all mines in the Tri-State or Joplin region of Kansas, Missouri, and Oklahoma.

Few drill rigs were operated in the region in 1938, and most of them were in the old camps in southwestern Missouri. Development was most active in the Oronogo, Neck City, Waco, Stark City, and Joplin areas.

Of the 361,526 tons of zinc concentrates shipped from the Tri-State region in 1938, it is estimated that flotation concentrates comprised about 171,400 tons. Flotation galena concentrates are estimated at 8,800 tons. Since the extension of flotation the average grade of the galena concentrates has decreased, whereas that of the sphalerite has increased. Some of the galena from the jigs and tables has a lead content of 80 percent (and above), but the flotation galena does not average more than 70 percent. The small quantity of galena produced at tailing mills is of low grade, averaging 48 to 65 percent. About 50 large and small mines were worked in southwestern Missouri in 1938; only 16 mills were operated.

Small mining operations and churn drilling were handicapped by low prices for ore, and the work done was not particularly successful in most areas. Small bodies of ore were located but few of any size. A drilling campaign was started at the old Aurora camp in an endeavor to revive mining in that vicinity, which has been at a standstill for several years. The only fair-size body of good-grade ore was drilled by the Eagle-Picher Mining & Smelting Co. at Stark City. A shaft was sunk and ore shipped to the Central mill at Cardin, Okla., in December 1938. Another shaft is being sunk and drilling continued. Shipments of crude ore from this property probably will exceed 1,500 tons a week in 1939. An undertaking that involved good engineering and a large expenditure of money was that at the old Oronogo Circle mine, which has yielded ore worth many millions of dollars. Power shovels and trucks have been removing shale and waste from the large open cave and old underground workings. The work, which is being done by the Oronogo Mutual Mining Co., is still in progress, but late in December ore was being taken from open-cuts and trucked to a 250-ton concentrating plant built by the Eagle-Picher Mining & Smelting Co. to handle this ore and that of other mines at Oronogo, Neck City, and Alba.

Among the larger producers of concentrates in southwestern Missouri in 1938 were the Missouri Mining Co. at Chitwood and Mineral Recoveries at Webb City, both of which operate tailing mills. Large producers from crude ore were the Oronogo Mutual Mining Co., D. C. & E. mine, and F. M. Mining Co., at Oronogo; Federal Mining & Smelting Co., Spring City; Playter Mining Co., Waco; Burton Mining Co., Joplin; United Mines, Inc., Diamond; Webb City Lead-Zinc Co., Webb City; United Zinc & Lead Co. and Little Phoebe, Wentworth; and Mary Arnold Mining Co., Ozark. The largest shippers of zinc silicate were Pilant & Ogle of Granby. About 119,400 tons of crude ore from Missouri mines were shipped to the Central mill at Cardin, Okla. Other smaller producers were the Ritter Mining Co., Pflug

Mining Co., Happy Hollow Mining Co., Luther Eakins, and Sterling Lead-Zinc Co.

The lead ore (3,668,400 tons) mined in 1938 in southeastern Missouri yielded 4.45 percent in galena concentrates averaging 74.8 percent lead. The mines and mills of the St. Joseph Lead Co., with a daily capacity of 20,500 tons, were operated at about 75 percent of capacity in 1938 and the Mine La Motte Corporation mine and mill at about the same rate. The Annapolis mine and mill in Iron County were operated part of the year by the Basic Metals Mining Co. The Ozark Lead Co. worked the Fleming tract at Fredericktown about 6 months in 1938. The crude ore was milled at the Clark & Hallock Milling Co. plant which was built in 1938. Mining was done on the 93-foot level, and the galena recovered was satisfactory in quantity and grade. Of the concentrates made at mills in southeastern Missouri, 73,884 tons were flotation galena concentrates in 1938 compared with 98,137 tons in 1937.

Oklahoma.—The most important event in Oklahoma and in the Tri-State lead and zinc region was the purchase by the Eagle-Picher Mining & Smelting Co. of virtually all of the 55,000 shares of the Commerce Mining & Royalty Co. The purchase was completed December 28, 1938, after many months of negotiations and a complete survey of all the Commerce properties. Eagle-Picher is now in possession of all lands, leases, mills, supplies, and equipment, as well as the large electric-power plant, of the company. The Northeast Oklahoma Ry. Co., which has numerous loading points in the Kansas and Oklahoma parts of the Tri-State region, will be operated by Eagle-Picher. The purchaser acquired large reserves of ore needed for its many integrated operations and an ample supply of crude ore for its 10,000-ton (daily) Central mill at Cardin. The field operating offices of the Eagle-Picher mine have been moved to Miami and Cardin. It is expected that the revamped Central mill, with its differential-tension density cone in good working condition, will be brought up to capacity and that the increased quantity of ore handled at that plant will permit the dismantling of several smaller mills. The large stocks of galena held by Commerce have been shipped to the Galena (Kans.) smelter. Little drilling was done in Oklahoma in 1938 for, although the ore reserves of many mines are nearing exhaustion, prices paid for concentrates have been too low to permit much money to be spent for exploration or development. Even if new bodies of ore are located it is improbable that any new milling plants will be constructed, as existing mills can handle more crude ore than is being mined.

About 30 mills of various sizes were operating in Oklahoma at the end of 1938. At least 65 operators did not mill their crude ore but shipped it to custom concentrating plants or central mills. The Tri-State Zinc & Lead Ore Producers Association reported that at the end of 1938 the stocks at mines in the Tri-State region were 8,402 tons of sphalerite and 8,620 tons of galena; all but 900 tons of the galena was shipped in January 1939, so that the total stocks of concentrates in mine bins were down to a little more than a week's demand over the current weekly output.

A large part of the concentrates from the tailing mills and from the central mills is a flotation product. The tailing mills produce very small quantities of low-grade galena, and the flotation galena at the large mills treating crude ore is of lower grade than the jig and table galena; on the other hand, much of the flotation sphalerite made is of higher grade than the coarse concentrates.

Nearly 1,177,000 tons more old tailings than crude ore were treated in Oklahoma in 1938, and the tailings yielded 20 percent of the sphalerite.

There was no production from the Peoria or Davis camps in 1938 or 1937. Mines near Commerce were operated part of the year, and the Cactus and Lost Trail leases produced galena and sphalerite at small mills or shipped crude ore to custom mills. The shippers in the Sunnyside-Quapaw area were the Kansas & Oklahoma Mining Trust, Atlas Milling Co., Century Zinc Co. (Scott), and St. Louis Smelting & Refining Co. (No. 4). In the central and western parts of the Oklahoma section of the Tri-State region the following mills were run partly on ore and partly on tailings: Lawyers Lead & Zinc Co., Skelton Lead & Zinc Co., Evans Wallower Zinc, Inc., and Rialto Mining Corporation. The following mills treated tailings only: Cardin Mining & Milling Co. (Nos. 2 and 3), Commerce Mining & Royalty Co. (Beaver), Britt Mining Co., Tri-State Zinc, Inc. (two mills), Andrews Mining & Milling Co., Cortez King Brand Mining Co., and C. Y. Semple. The Eagle-Picher Mining & Smelting Co.—Central and Mary M. Beck mills—treated more crude ore than any other operator in the region; its mills and the Bird Dog, See Sah, and Blue Goose mills of the Commerce Mining & Royalty Co. treated about two-thirds of all the Oklahoma crude ore milled in 1938. Other large outputs were made by the Rialto Mining Corporation, Evans Wallower Zinc, Inc. (No. 4), Oklahoma Interstate Mining Co. (Woodchuck), United Zinc Smelting Corporation, Kansas Exploration Co. (Ritz), Guaranty Mining & Royalty Co., Cortez King Brand Mining Co. (New York and Oberman mines), Indian Mining & Milling Co., Black Mining Co., Lula Belle Mining Co., Baird Mining Co., Blue Ribbon Mining Co., Federal Mining & Smelting Co. (Gordon), and Lavrion Mining Co.

Some of the larger shippers in Oklahoma to custom or central mills were the Davis Big Chief Mining Co., Craig Mining Co., Cameron & Henderson, J. Dryer, Henderson Mining Co., Andrews Mining Co., Childress Mining Co. (Acme), Southeastern Mining Co. (Hope), New Deal Mining Co., Romo Mining Co., Tongaha Mining Co., Gray Wolf Mining Co., and Needmore Mining Co. The Bird Dog mill received ore from many of the leases belonging to the Commerce Mining & Royalty Co., including the Anna Beaver and Scammon Hill mines. Virtually all the tailings treated were handled by gasoline power shovels, the remainder by draglines. The new 1,200-ton Gordon mill of the Federal Mining & Smelting Co., which was completed in November 1937, treated all ore mined by the company in Oklahoma. The Mary M concentrating plant received custom ores from 8 mines, and the Royal plant from about 10 mines including the Mary Alice, Hope, Aztec, and Indiana.

Mine shipments of lead and zinc in Oklahoma, 1934–38

Year	Lead concentrates (galena)		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	21,889	$851,523	204,283	$5,523,966	16,747	$1,239,278	107,772	$9,268,392
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

[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, 1937–38

	1937		1938	
	Crude ore	Old tailings and slimes	Crude ore	Old tailings and slimes
Total ore, etc., milled ... short tons	3,787,600	6,644,400	3,072,400	4,249,000
Total concentrates shipped:				
Galena ... do	38,906	540	27,208	400
Sphalerite ... do	191,046	64,793	167,250	41,234
Ratio of concentrates to ore, etc:				
Lead ... percent	1.03	------------	0.91	0.01
Zinc ... do	5.15	0.98	5.30	.97
Metal content of ore, etc.:				
Lead ... do	.80	------------	.71	------------
Zinc ... do	3.11	.60	3.19	.58
Average lead content of galena concentrates ... do	77.4	60.0	78.0	52.0
Average zinc content of sphalerite concentrates ... do	60.3	60.1	60.2	60.1
Average value per ton:				
Galena concentrates	$69.45	$51.05	$52.62	$35.79
Sphalerite concentrates	40.80	40.65	30.61	30.83

Mine production of lead and zinc concentrates in Oklahoma, 1891–1938, 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]	1,240,581	$101,770,268	7,081,483	277,355,069	164	2,692
Peoria	2,639	127,163	220	8,289	3,120	79,649
	1,243,220	101,897,431	7,082,261	277,390,757	4,183	106,933

[1] Including Quapaw and Sunnyside.

Wisconsin.—The output of galena concentrates in 1938 in Wisconsin was less than one-third of that in 1937. Shipments of sphalerite decreased substantially, and the grade of the raw concentrates was lower; the recovered zinc decreased 4,865 tons. About half the raw concentrates were treated at the Cuba City roasting plant, which was abandoned early in 1938, and the rest were treated at a flotation plant built in 1938. The Vinegar Hill Zinc Co. worked the Mullen No. 2 and Winskill-Petersen mines 90 days, closing them in March 1938. Small lots of crude ore were shipped to the Vinegar Hill concentrating plants from about 30 small mines at Shullsburg, New Diggings, Linden, Highland, Hazel Green, Dodgeville, Cuba City, and Benton. The shippers included the McKinley Mining Co., which did not operate its mill in 1938. The Pacquette mine at Shullsburg, operated by C. J. Rodham, produced no ore, but a new shaft was sunk and flotation equipment was added to the concentrating plant.

Mine production of lead and zinc in Wisconsin, 1934–38

Year	Lead concentrates		Zinc concentrates (sphalerite)		Metal content [1]			
					Lead		Zinc	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	340	$12,586	31,489	$365,839	234	$17,316	9,807	$843,402
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	121,180	320	29,440	2,073	199,008

[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 ore and metal it should be borne in mind that the value given for the ore is that actually received by the producer, whereas the value of the lead and zinc is calculated from the average price for all grades.
[2] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.

Tenor of lead and zinc ore and concentrates produced in Wisconsin, 1935–38

	1935	1936	1937	1938
Total ore ... short tons	236,000	284,800	285,000	58,700
Total concentrates in ore:				
Lead ... percent	0.17	0.45	0.56	0.84
Zinc ... do	14.00	13.44	13.00	[1] 6.64
Metal content of ore:				
Lead ... do	.12	.32	.29	.55
Zinc ... do	4.85	3.61	3.12	3.91
Average lead content of galena concentrates ... do	73.3	72.2	70.1	67.0
Average zinc content of sphalerite concentrates ... do	34.6	27.0	24.0	18.5
Average value per ton:				
Galena concentrates	$42.62	$48.08	$68.85	$42.70
Sphalerite concentrates	11.48	10.47	11.99	(2)

[1] The zinc concentrates shipped in 1938 were a flotation product or raw concentrates roasted at Cuba City, Wis. No raw concentrates were shipped in 1938; about 13,000 tons were produced.
[2] Not given.

The raw sphalerite concentrates averaged about 18.5 percent zinc and were treated at either a roasting plant or flotation plant to make a product, containing about 59.2 percent zinc, which was shipped to smelters and brought an average price of $31.11 a ton. Flotation concentrates made in 1938 comprised 788 tons of 60-percent zinc concentrates and 155 tons of 60-percent galena concentrates.

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 in 1938 decreased $8,812,081, or 23 percent, from that in 1937. The value of the lead output declined $3,757,614; silver, $2,872,397; zinc, $2,818,990; and copper, $120,900. The value of the gold output increased $757,820. The decreases in average sales prices of lead, silver, and zinc in 1938 caused curtailment or suspension of operations at the large zinc-lead properties in the Coeur d'Alene region, the chief metal-producing area in Idaho; however, the output of zinc-lead ore from the Warm Springs district in Blaine County increased 51 percent. Production of gold in Idaho in 1938 (103,513 fine ounces) was the largest since 1896, owing to increased output from both lode mines and placers, and that of silver (18,993,676 fine ounces) was only 3 percent less than the record output of 1937; but the output of zinc declined 19 percent and that of lead 11 percent.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Idaho, 1934–38, and total, 1863–1938, 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
1934	291	1,172	1,287,182	84,817.20	$2,964,361	7,394,143	$4,780,052
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
1863–1938			(1)	7,216,200.00	155,706,403	418,127,937	286,172,222

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	1,531,625	$122,530	142,648,216	$5,277,984	49,598,651	$2,132,742	$15,277,669
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
1863–1938	[2] 88,273	28,177,989	[2] 5,217,325	556,935,252	[2] 676,133	93,089,861	1,120,081,727

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Idaho, 1934–38, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Drift mining		Dragline dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1934	[2] 8,155.62	[2] 2,350	(2)	(2)	3,248.70	593	15,852.05	5,585	27,256.37	8,528
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

[1] Power-shovel excavators with floating washing plants or special amalgamators.
[2] Figures for sluicing and hydraulic include those for drift mining.

Gold.—The output of recoverable gold in Idaho was 26 percent greater in 1938 than in 1937 and was the largest since 1896 when it was 112,409 ounces. Gold output from lode mines increased 20 percent and that from placers 33 percent; most of the gain in gold from placers came from dragline operations. About 52 percent of the State total gold output in 1938 came from placer operations; 30 percent of the total lode and placer was recovered by connected-bucket dredges and 17 percent by dragline dredges. Nine floating (bucket) dredges treated a total of 6,693,700 cubic yards of gravel and recovered 31,234 ounces of gold, an increase of 2,272 ounces over 1937; and 19 dragline dredges treated a total of 2,173,000 yards of gravel and recovered 17,448 ounces of gold, an increase of 10,589 ounces. Of the total placer gold, 82 percent came from the Boise Basin, Warren, Carson, Newsome, and West View (Gem County) districts where dredges were operated. Gold from placer and lode operations in the Boise Basin district comprised 26 percent of the State total. About 79 percent of the lode gold came from the Boise Basin, Marshall Lake, Middle Boise, Warm Springs, Yellow Pine, Ten Mile, Ramey Ridge, Mineral Hill, and Orogrande districts and the Coeur d'Alene region. Increases in gold were recorded in the Middle Boise, Warm Springs, Mineral Hill, Ramey Ridge, and Ten Mile districts, but decreases in the Seven Devils and Yellow Pine districts. Siliceous gold ore and old tailings yielded 39 percent of the total gold in 1938.

The Fisher-Baumhoff Co., operating two bucket dredges near Centerville, was again the largest gold producer in Idaho. It was followed by the Moores Creek Dredging Co. at Idaho City; the Golden Anchor mine at Burgdorf; the Warren Dredging Co. at Warren; Newsome Creek Placers near Golden; the Jordan Creek dredge at De Lamar; the Triumph (Snyder Mines, Inc.) mine near Hailey;

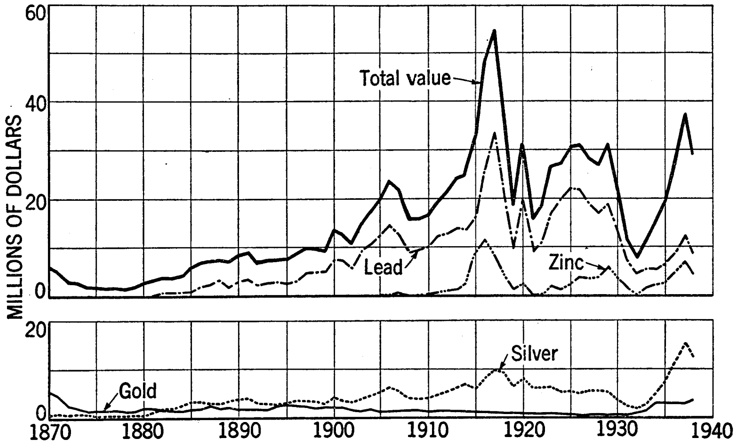

FIGURE 1.—Value of mine production of gold, silver, lead, and zinc and total value of gold, silver, copper, lead, and zinc in Idaho, 1870–1938. The value of copper has been less than $2,000,000 annually except in a few years.

Ralph Davis, Inc. (dredge), at Montour; the Yellow Pine Co. at Stibnite; the Mayflower mine at Placerville; and the Boise-Rochester property at Atlanta.

Silver.—The output of recoverable silver in Idaho was 18,993,676 fine ounces in 1938, a decrease of 3 percent from the record output of 1937. Virtually all the large producers of silver in the Coeur d'Alene region reported decreases except the Polaris mine which reported a substantial gain. There was also a substantial increase in silver output from the Warm Springs district. The Coeur d'Alene region produced 91 percent of the State total silver in 1938; the remainder came chiefly from the Warm Springs, Bayhorse, Blue Wing, Pend d'Oreille, Boise Basin, Carson, and Middle Boise districts. Silver ore yielded 72 percent of the State total silver, zinc-lead ore 19 percent, and lead ore 8 percent. Production of silver from silver ore decreased 519,213 ounces and that from lead ore also decreased, but the output from zinc-lead ore increased 469,709 ounces.

The Sunshine mine, largest producer of silver in the United States, decreased its output from 12,152,000 ounces in 1937 to 11,352,154 ounces in 1938. Eight mines—the Sunshine, Polaris, Bunker Hill, Hecla, Triumph, Morning, Crescent, and Page—produced 94 percent of the silver output of the State in 1938. All these mines, except the Triumph, are in the Coeur d'Alene region.

Copper.—The output of recoverable copper in Idaho was 4,278,000 pounds in 1938, a decrease of 4 percent from 1937. Mines in the Coeur d'Alene region produced 88 percent of the total (nearly 72 percent from silver ore, 12 percent from zinc-lead ore, 4 percent from lead ore, and a little from gold ore); 5 percent came from gold ore from the McDevitt and Ramey Ridge districts. The Sunshine mine produced more than half the State total copper in 1938; most of the remainder came from the Polaris, Bunker Hill, Copper Queen, and Morning mines.

Lead.—The output of recoverable lead in Idaho was 184,354,000 pounds in 1938, a decrease of 11 percent from 1937. More than 89 percent of the total came from the Coeur d'Alene region and 8 percent from the Warm Springs district; considerable lead was produced also in the Bayhorse, Pend d'Oreille, Port Hill, and Texas districts. Zinc-lead material from the Coeur d'Alene region and the Warm Springs district yielded 75 percent of the State total lead in 1938; lead ore, chiefly from the Coeur d'Alene region, yielded 23 percent. Lead recovered from lead ore decreased 20,895,011 pounds and that from zinc-lead material 2,611,776 pounds. The combined lead output of the three largest producers—Bunker Hill, Hecla, and Morning—was 134,740,600 pounds, or 73 percent of the State total; other large producers of lead were the Triumph, Page, Star, Sherman, Gold Hunter, Blackhawk, Clayton, and Jack Waite properties.

Zinc.—The output of recoverable zinc in Idaho was 88,060,000 pounds in 1938, or 19 percent less than the record output of 1937. The decrease was due entirely to curtailment of operations at zinc-lead mines in the Coeur d'Alene region, as the output of zinc from the Warm Springs district increased from 13,918,000 pounds in 1937 to 24,140,000 pounds in 1938. More than 72 percent of the State total zinc in 1938 came from the Coeur d'Alene region and nearly all the remainder from the Warm Springs district. Three mines—the Morning, Triumph, and Bunker Hill—produced 77 percent of the State total, and the rest came chiefly from the Star, Frisco, Page, and Hecla mines. Zinc-lead ore and old tailings yielded 99 percent of the total and lead ore the remainder.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, 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	3	10	577	$20,195	113	$73
Adams	5	2	293	10,255	382	247
Benewah		1	4	140		
Blaine	24	2	5,055	176,925	1,059,993	685,248
Boise	36	75	27,730	970,550	49,828	32,212
Bonner	9		65	2,275	62,899	40,662
Bonneville	1	4	124	4,340		
Boundary	3		34	1,190	14,041	9,077
Butte	3		141	4,935	20,298	13,122
Camas	5	2	442	15,470	1,086	702
Canyon		1	3	105		
Cassia	1				96	62
Clark	1				3	2
Clearwater	2	42	1,101	38,535	229	148
Custer	19	13	461	16,135	180,610	116,758
Elmore	16	31	7,103	248,605	39,566	25,578
Gem	4	5	4,049	141,715	4,288	2,772
Gooding		2	8	280		
Idaho	63	130	32,903	1,151,605	38,627	24,971
Jerome		11	266	9,310	17	11
Kootenai		1	2	70		
Latah		11	55	1,925		
Lemhi	38	54	6,293	220,255	78,374	50,666
Lewis		1	6	210		
Nez Perce		6	72	2,520	17	11
Owyhee	21	12	7,726	270,410	50,473	32,629
Power		4	24	840		
Shoshone	43	20	4,053	141,855	17,325,379	11,200,245
Twin Falls		6	85	2,975	3	2
Valley	7	16	4,832	169,120	33,001	21,334
Washington	1	1	6	210	34,353	22,208
	305	463	103,513	3,622,955	18,993,676	12,278,740
Total, 1937	347	741	81,861	2,865,135	19,587,766	15,151,137

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Ada	51	$5	1,783	$82			$20,355
Adams	17,745	1,739					12,241
Benewah							140
Blaine	107,174	10,503	14,772,065	679,515	24,144,083	$1,158,916	2,711,107
Boise	4,765	467	129,674	5,965			1,009,194
Bonner	4,643	455	1,351,826	62,184	41,792	2,006	107,582
Bonneville							4,340
Boundary	3,418	335	585,891	26,951			37,553
Butte	806	79	61,239	2,817			20,953
Camas	1,796	176	8,130	374			16,722
Canyon							105
Cassia	41	4	304	14			80
Clark	1,439	141					143
Clearwater							38,683
Custer	39,592	3,880	1,932,022	88,873			225,646
Elmore							274,183
Gem	500	49	4,348	200			144,736
Gooding							280
Idaho	55,531	5,442	24,413	1,123			1,183,141
Jerome							9,321
Kootenai							70
Latah							1,925
Lemhi	256,214	25,109	767,304	35,296			331,326
Lewis							210
Nez Perce							2,531
Owyhee			978	45			303,084
Power							840
Shoshone	3,765,795	369,048	164,547,979	7,569,207	63,874,125	3,065,958	22,346,313
Twin Falls							2,977
Valley	3,786	371	132,935	6,115			196,940
Washington	14,704	1,441	33,109	1,523			25,382
	4,278,000	419,244	184,354,000	8,480,284	88,060,000	4,226,880	29,028,103
Total, 1937	4,464,000	540,144	207,422,000	12,237,898	108,398,000	7,045,870	37,840,184

Gold and silver produced at lode mines in Idaho in 1938, 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	624	177	82	Custer	39,833	199	180,313
Adams	227	274	379	Elmore	17,808	5,925	39,368
Blaine	108,290	5,047	1,059,993	Gem	84	105	3,892
Boise	31,798	6,379	44,598	Idaho	143,318	15,580	33,957
Bonner	12,994	65	62,899	Lemhi	65,144	5,161	78,261
Bonneville	10	9		Owyhee	11,767	870	44,386
Boundary	4,201	34	14,041	Shoshone	1,514,278	3,769	17,325,342
Butte	1,135	141	20,298	Valley	40,367	4,716	32,984
Camas	737	201	939	Washington	688	1	34,353
Cassia	8		96				
Clark	3		3		1,999,147	49,434	18,976,348
Clearwater	5,833	781	164	Total, 1937	2,075,402	41,321	19,575,479

Gold and silver produced at placer mines in Idaho in 1938, by counties, in fine ounces, in terms of recovered metals

County	Sluicing, and hydraulic and sluicing		Drift mining		Dragline dredges [1]		Floating (bucket) dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Ada	76	15			324	16			400	31
Adams	19	3							19	3
Benewah	4								4	
Blaine	8								8	
Boise	606	140	57	8	2,139	529	18,549	4,553	21,351	5,230
Bonneville	115								115	
Camas	3	1					238	146	241	147
Canyon	3								3	
Clearwater	241	47			79	18			320	65
Custer	100	193			162	104			262	297
Elmore	252	61			926	137			1,178	198
Gem	11	4			3,933	392			3,944	396
Gooding	8								8	
Idaho	1,615	321	149	25	7,379	1,617	8,180	2,707	17,323	4,670
Jerome	266	17							266	17
Kootenai	2								2	
Latah	55								55	
Lemhi	1,127	113	5						1,132	113
Lewis	6								6	
Nez Perce	72	17							72	17
Owyhee	83	4			2,506	3,389	4,267	2,694	6,856	6,087
Power	24								24	
Shoshone	91	13	193	24					284	37
Twin Falls	85	3							85	3
Valley	115	17	1						116	17
Washington			5						5	
	4,987	969	410	57	[2] 17,448	[2] 6,202	[3] 31,234	[3] 10,100	54,079	17,328
Total, 1937	4,286	1,399	433	65	6,859	1,652	28,962	9,171	40,540	12,287

[1] Power-shovel excavators with floating washing plants or special amalgamators.
[2] Recovered from 2,713,000 cubic yards of gravel treated by 19 dragline dredges.
[3] Recovered from 6,693,700 cubic yards of gravel treated by 9 connected-bucket dredges.

MINING INDUSTRY

The average sales prices of both lead and zinc dropped rapidly during the first half of 1938, and although prices strengthened somewhat during the latter half of the year the yearly averages were considerably lower than in 1937; lead was off 1.3 cents a pound and zinc 1.7 cents. These declines, combined with the reduction in the silver price to 64.6+ cents an ounce, resulted in curtailment in output of silver, lead, and zinc by virtually all the large mines in the Coeur d'Alene region. Production of zinc in Idaho decreased 19 percent in quantity and 40 percent in value; lead, 11 and 31 percent, respectively; and silver, 3 and 19 percent, respectively. The decreases in output of metals in the Coeur d'Alene region were offset in part by a large increase in output of zinc-lead ore from Blaine County and by increases in gold from both lode mines and placers.

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 1938, 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	189	283,204	40,305	130,287	250,190	242,496	
Dry and siliceous gold-silver ore	16	15,672	2,123	90,692	1,631	205,342	
Dry and siliceous silver ore	28	444,456	1,065	13,599,812	3,142,508	1,835,028	
	[1] 232	743,332	43,493	13,820,791	3,394,329	2,282,866	
Copper ore	9	165	58	1,339	34,361	665	
Lead ore	55	272,904	831	1,449,666	221,385	42,665,859	643,000
Zinc-lead ore	23	982,746	5,052	3,704,552	627,925	139,404,610	87,417,000
Total, lode mines	[1] 305	1,999,147	49,434	18,976,348	4,278,000	184,354,000	88,060,000
Total, placers	463		54,079	17,328			
	768	1,999,147	103,513	18,993,676	4,278,000	184,354,000	88,060,000
Total, 1937	1,088	2,075,402	81,861	19,587,766	4,464,000	207,422,000	108,398,000

[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 1,999,147 tons of ore (including old tailings) produced in 1938 in Idaho, 186,163 tons (9 percent) were treated at amalgamation and cyanidation mills, 1,779,815 tons (89 percent) were treated at concentration plants, and 33,169 tons (2 percent) were shipped for smelting.

The ore treated at amalgamation and cyanidation mills comprised 12,490 tons treated at straight amalgamation plants, yielding 2,458 ounces of gold and 730 ounces of silver; 59,987 tons treated at combined amalgamation and concentration plants, yielding 11,001 ounces of gold and 5,581 ounces of silver in amalgamation bullion and 616 tons of concentrates; and 113,686 tons treated at straight cyanidation plants. The ore treated at the cyanidation plants contained 4,270 ounces of gold and 3,109 ounces of silver, indicating cyanide extractions of 67 percent of the gold and 60 percent of the silver; the plants used 106,676 pounds of sodium cyanide (91-percent grade), 13,808 pounds of zinc dust, and 600,725 pounds of lime.

The ore treated at concentration plants comprised 93,911 tons of gold ore, 13,105 tons of gold-silver ore, 437,366 tons of silver ore, 252,687 tons of lead ore, and 982,746 tons of zinc-lead ore.

Details of the treatment of all ores produced in Idaho in 1938 are given in the tables that follow.

Mine production of metals in Idaho in 1938, 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	72,477	13,459	6,311			
Ore and old tailings cyanided	113,686	2,855	1,878			
Concentrates smelted [1]	260,462	26,030	18,099,795	4,086,156	170,775,538	88,060,000
Ore and old tailings smelted	33,169	7,090	868,364	191,844	13,578,462	
Placer		54,079	17,328			
		103,513	18,993,676	4,278,000	184,354,000	88,060,000
Total, 1937		81,861	19,587,766	4,464,000	207,422,000	108,398,000

[1] Includes zinc concentrates treated at electrolytic plants.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Idaho in 1938, 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	583	120	14	13	18	2	51	
Blaine	25	7	8					
Boise	11,806	1,976	553	16	137	666	191	534
Bonneville	10	9						
Camas	10	11	3					
Clearwater	30	17	4					
Elmore	16,315	1,903	1,600	162	821	12,751		
Gem	2	2	1					
Idaho	25,394	8,354	3,658	120	1,457	17,827	898	3,282
Lemhi	13,993	420	66	282	739	2,201	181,602	4,500
Owyhee	525	72	62	19	67	259		826
Shoshone	20	19	3					
Valley	3,764	549	339	4	150	350		
	72,477	13,459	6,311	616	3,389	34,056	182,742	9,142
Total, 1937	65,673	14,348	5,768	255	2,161	28,491	111,478	3,339

CYANIDATION MILLS

County	Material treated	Gold	Silver	Concentrates produced	Gold	Silver	Copper	Lead
Blaine	1,400	138	535					
Clearwater	5,803	764	160					
Idaho	106,483	1,953	1,183					
	113,686	2,855	1,878					
Total, 1937	79,383	6,897	2,709	44	110	94		
Grand total: 1938	186,163	16,314	8,189	616	3,389	34,056	182,742	9,142
1937	145,056	21,245	8,477	299	2,271	28,585	111,478	3,339

Mine production of metals from concentrating mills in Idaho in 1938, by counties, in terms of recovered metals

County	Ore and old tailings 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	103, 944	47, 360	3, 719	1, 017, 887	104, 318	14, 557, 383	24, 144, 083
Boise	19, 724	800	3, 488	25, 506	1, 225	120, 000	----------
Bonner	12, 892	1, 047	62	50, 983	2, 962	1, 293, 145	41, 792
Boundary	4, 200	439	30	14, 040	3, 418	585, 891	----------
Camas	450	33	86	387	946	3, 480	----------
Custer	39, 004	1, 359	53	124, 676	17, 703	1, 691, 808	----------
Elmore	3	1	3	1	----------	----------	----------
Idaho	11, 313	482	3, 637	10, 361	54, 633	20, 892	----------
Lemhi	49, 890	2, 035	3, 698	63, 388	57, 643	206, 246	----------
Owyhee	11, 143	91	673	36, 343	----------	152	----------
Shoshone	1, 491, 009	203, 979	3, 646	16, 698, 737	3, 657, 362	152, 263, 529	63, 874, 125
Valley	36, 243	2, 220	3, 546	23, 430	3, 204	23, 870	----------
	1, 779, 815	259, 846	22, 641	18, 065, 739	3, 903, 414	170, 766, 396	88, 060, 000
Total, 1937	1, 894, 447	294, 654	12, 856	18, 550, 344	4, 018, 221	192, 001, 069	108, 398, 000

Gross metal content of Idaho concentrates produced in 1938, 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	4,170	14,248	68,674	9,164	163,487	----------
Dry gold-silver	130	819	37,127	----------	163	----------
Dry silver	1,368	50	68,811	78,623	164,217	----------
Copper	12,192	2,914	11,377,193	3,129,570	721,575	----------
Lead	137,973	4,641	4,310,708	657,108	170,978,162	14,049,147
Lead-copper	4,009	476	1,837,906	843,866	815,880	----------
Zinc	89,538	970	366,501	328,728	4,849,380	96,798,500
Iron (from zinc-lead ore)	11,082	1,912	32,875	17,700	363,100	619,400
	260,462	26,030	18,099,795	5,064,759	178,055,964	111,467,047
Total, 1937	294,953	15,127	18,578,929	5,163,988	200,600,901	139,185,509

Mine production of metals from Idaho concentrates in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ada	13	18	2	51	----------	----------
Blaine	47,360	3,719	1,017,887	104,318	14,557,383	24,144,083
Boise	816	3,625	26,172	1,416	120,534	----------
Bonner	1,047	62	50,983	2,962	1,293,145	41,792
Boundary	439	30	14,040	3,418	585,891	----------
Camas	33	86	387	946	3,480	----------
Custer	1,359	53	124,676	17,703	1,691,808	----------
Elmore	163	824	12,752	----------	----------	----------
Idaho	602	5,094	28,188	55,531	24,174	----------
Lemhi	2,317	4,437	65,589	239,245	210,746	----------
Owyhee	110	740	36,602	----------	978	----------
Shoshone	203,979	3,646	16,698,737	3,657,362	152,263,529	63,874,125
Valley	2,224	3,696	23,780	3,204	23,870	----------
	260,462	26,030	18,099,795	4,086,156	170,775,538	88,060,000
Total, 1937	294,953	15,127	18,578,929	4,129,699	192,004,408	108,398,000
BY CLASSES OF CONCENTRATES						
Dry gold	4,170	14,248	68,674	6,989	153,523	----------
Dry gold-silver	130	819	37,127	----------	152	----------
Dry silver	1,368	50	68,811	55,115	157,664	----------
Copper	12,192	2,914	11,377,193	2,554,402	691,209	----------
Lead	137,973	4,641	4,310,708	531,971	164,143,095	----------
Lead-copper	4,009	476	1,837,906	685,533	782,812	----------
Zinc	89,538	970	366,501	235,049	4,574,790	88,060,000
Iron (from zinc-lead ore)	11,082	1,912	32,875	17,097	272,293	----------
	260,462	26,030	18,099,795	4,086,156	170,775,538	88,060,000

Gross metal content of Idaho crude ore and old tailings shipped to smelters in 1938, by classes of ore

Class of ore	Ore and old tailings smelted	Gross metal content			
		Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous gold	3,160	4,859	30,407	6,990	37,542
Dry and siliceous gold-silver	3,574	1,568	82,313	3,112	246,428
Dry and siliceous silver	8,083	33	310,774	101,072	226,358
Copper	165	58	1,339	38,629	709
Lead	18,187	572	443,531	86,059	13,677,360
	33,169	7,090	868,364	235,862	14,188,397
Total, 1937	35,899	4,949	988,073	394,740	16,081,965

Mine production of metals from Idaho crude ore and old tailings shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore and old tailings	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Ada	41	39	66		1,783
Adams	227	274	379	17,745	
Blaine	2,921	1,183	41,563	2,856	214,682
Boise	268	778	17,873	3,349	9,140
Bonner	102	3	11,916	1,681	58,681
Boundary	1	4	1		
Butte	1,135	141	20,298	806	61,239
Camas	277	104	549	850	4,650
Cassia	8		96	41	304
Clark	3		3	1,439	
Custer	829	146	55,637	21,889	240,214
Elmore	1,490	3,198	25,016		
Gem	82	103	3,891	500	4,348
Idaho	128	179	928		239
Lemhi	1,261	304	12,606	16,969	556,558
Owyhee	99	58	7,722		
Shoshone	23,249	104	626,602	108,433	12,284,450
Valley	360	471	8,865	582	109,065
Washington	688	1	34,353	14,704	33,109
	33,169	7,090	868,364	191,844	13,578,462
Total, 1937	35,899	4,949	988,073	334,301	15,417,592

BY CLASSES OF ORE

Dry and siliceous gold	3,160	4,859	30,407	5,869	32,254
Dry and siliceous gold-silver	3,574	1,568	82,313	2,593	198,429
Dry and siliceous silver	8,083	33	310,774	81,009	214,527
Copper	165	58	1,339	34,361	665
Lead	18,187	572	443,531	68,012	13,132,587
	33,169	7,090	868,364	191,844	13,578,462

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
Ada County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Black Hornet	2		585	141		17	51			$4,951
Blacks Creek	1		39	36		65		1,783		1,384
Highland (Boise River)		4			56	14				1,969
Snake River		3			335	17				11,736
Adams County:										
Rock Flat		1			14	3				492
Seven Devils	5		227	274		379	17,745			11,574
Blaine County:										
Mineral Hill	16		1,864	576		3,813	1,939	24,239	4,083	24,126
Sawtooth	2		145	163		1,239	133	4,826		6,741
Warm Springs	5	2	106,131	4,308	8	1,054,746	104,959	14,740,543	24,140,000	2,679,987
Boise County:										
Boise Basin	23	68	30,792	5,962	21,319	46,694	1,908	127,891		991,091
Eight Mile Creek	1		20	33		17				1,166
Grimes Pass	4		719	230		1,304	2,704	1,674		9,235
North Fork	1		43			1,646	133	109		1,082
South Fork of Payette River		3			19					665
Summit Flat	4		202	142		96				5,032
West View	1		19	9		68	20			361
Bonner County:										
Lakeview	1		304	56		4,291	2,847	55,696	41,792	9,581
Pend d'Oreille	8		12,690	9		58,608	1,796	1,296,130		98,001
Bonneville County: Mt. Pisgah	1	4	10	9	115					4,340
Boundary County:										
Moyie Yahk	2		201	34		212	71	3,848		1,511
Port Hill	1		4,000			13,829	3,347	582,043		36,042
Butte County:										
Dome	1		98	1		283	92	60,826		3,025
Lava Creek	2		1,037	140		20,015	714	413		17,928
Camas County:										
Little Smoky	4	2	724	156	241	1,069	1,796	8,130		15,136
Skeleton Creek	1		13	45		17				1,586
Clearwater County:										
Burnt Creek		4			18					630
Clearwater River		4			15					525
Moose Creek and Independence Creek		7			35	3				1,227
North Fork of Clearwater River		5			34	14				1,199
Pierce	2	21	5,833	781	216	212				35,032

Custer County:										
Alder Creek	4		184	2		3,270	398	100,696		6,855
Bayhorse	5		39,569	45		172,048	36,469	1,830,065		200,555
Copper Basin	1		37			362	2,439			473
Rough Creek		1			26	3				912
Stanley and Stanley Basin	1	4	2	6	192	130				7,014
Yankee Fork	8	4	41	146	39	4,797	286	1,261		9,662
Elmore County:										
Bear Creek	8	5	56	86	306	308				13,919
Boise River		6			117	34				4,117
Middle Boise	4	12	17,691	5,820	69	39,173				231,439
Neal	2		29	11		3				387
Snake River		7			684	34				23,962
Gem County: West View	4	5	84	105	3,944	4,288	500	4,348		144,736
Idaho County:										
American, Bully, and Castle Creeks		3			12					420
Camp Howard		8			617	116				21,670
Clearwater River		2			13					455
Dixie	11	14	1,475	336	148	297				17,132
Elk City	8	16	251	118	1,798	393				67,314
Florence	4	17	110	20	223	113				8,578
Lower Salmon River		5			27	3				947
Maggie and Pete King Creeks	2	2	6	5	10	795				1,039
Marshall Lake	3	9	10,438	5,869	222	19,308	775	2,304		225,849
Newsome		2			4,743	1,106				166,720
Orogrande	4	5	106,020	1,937	397	1,171		239		82,458
Ramey Ridge	3		5,742	2,517		9,139	53,000	11,109		99,708
Robbins	4	1	4,971	1,031	2	1,089	1,633	9,783		37,469
Salmon River (Riggins and French Creek)		4			229	48				8,046
Salmon River (near Shoup)		4			36	14				1,269
Simpson		9			119	17				4,176
Snake River		4			30	3				1,052
Ten Mile	11	8	13,576	3,102	785	1,635	123	674		137,145
Warren	13	11	729	645	7,889	3,380		304		300,889
Jerome County: Snake River		11			266	17				9,321
Latah County:										
Gold Creek		3			15					525
Hoodoo		4			23					805
Moscow Mountain		4			17					595
Lemhi County:										
Blue Wing	1		26,823	9		59,335	55,000	155,804		51,230
Boyle Creek and Carmen Creek	1		2,778	89		1,403	622	7,326		4,420
Eureka	4	4	389	236	28	198	10,510			10,398
Gibbonsville	9	11	1,513	668	697	492	408	870		48,173
Indian Creek	1		401	60		34	194			2,141
Junction	1		20			345		12,283		788
Kirtley Creek		1			65	14				2,284
McDevitt	1		10,075	401		1,850	181,602			33,028
Mackinaw	3	23	76	67	228	280	82	8,913		10,924
Mineral Hill	3	6	10,376	2,198	40	1,570		14,891		80,030
Pratt Creek and Sandy Creek	4		11,104	1,131		1,055	2,796	31,652		41,997
Salmon River		8			70	17				2,461

Mine production of gold, silver, copper, lead, and zinc in Idaho in 1938, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
Lemhi County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Texas	5		843	31		11,300	4,173	534,761		$33,398
Yellow Jacket	4		742	269		297	827	804		9,725
Nez Perce County:										
Salmon River		2			17	3				597
Snake River		4			55	14				1,934
Owyhee County:										
Carson	16	4	11,239	759	6,753	44,414		152		291,639
Castle Creek	4		520	100		6,042		826		7,444
Snake River		8			103	3				3,607
Steele	1		8	11		14				394
Power County: Snake River		4			24					840
Shoshone County:										
Beaver	3	6	3,936	6	13	3,578	245	235,609	434,604	34,701
Coeur d'Alene	1	5	20	19	72	20				3,198
Eagle	1		8,016	6		6,367		1,543,000	207,417	85,260
Evolution	4		387,410	821		12,952,662	2,920,663	1,159,674		8,741,743
Hunter	9		348,560	286		938,998	169,398	44,929,152	32,213,917	4,246,649
Lelande	8		275,521	416		1,329,160	249,745	46,376,326	7,102,333	3,372,513
Placer Center	5		14,586	20		82,269	18,000	1,980,261	750,000	182,740
St. Joe		4			41	3				1,437
Summit	4	5	6,033	1,323	158	1,038	1,265	74,391	14,250	56,736
Yreka	8		470,196	872		2,011,284	406,479	68,249,566	23,151,604	5,621,336
Twin Falls County: Snake River		6			85	3				2,977
Valley County:										
Big Creek		6			17	3				597
Deadwood Basin	3	3	439	58	7	5,807	1,500	23,870		7,274
Lake City		3			80	14				2,809
Pistol Creek	1		348	451		8,814	582	109,065		26,557
Thunder Mountain	2	2	3,700	678	8	676				24,447
Yellow Pine	1		35,880	3,529		17,687	1,704			135,116
Washington County: Washington	1		688	1		34,353	14,704	33,109		25,207
Other counties and districts [1]	8	30	200	13	95	495	1,623	2,761		4,386
Total Idaho	305	463	1,999,147	49,434	54,079	18,993,676	4,278,000	184,354,000	88,060,000	29,028,103

[1] Includes counties and districts with production valued at less than $350.

ADA COUNTY

The metal output of Ada County increased slightly in 1938; most of it was gold recovered from the New Deal & Hot Shot and Gold Flour placers on Snake River near Grand View and from gold ore treated by amalgamation and concentration at the Adelmann Bros. mine in the Black Hornet district. Placer operations were reported also in the Boise and Highland districts, and gold ore was shipped for smelting from a property on Blacks Creek.

ADAMS COUNTY

The value of the metal output of Adams County decreased from $149,869 in 1937 to $12,241 in 1938 owing to suspension of operations late in 1937 at the 25-ton cyanidation plant at the Placer Basin mine in the Seven Devils district; the Placer Basin Co. worked the mine in 1937 but ceased operations at the end of the year and dismantled the cyanide plant. The mine was operated 4 months in 1938, and 4 cars of gold ore were shipped to a smelter. The remainder of the county output in 1938 was chiefly copper ore from the River Queen, Lockwood, and Helena properties in the Seven Devils district.

BLAINE COUNTY

The value of the metal output of Blaine County increased from $1,842,899 in 1937 to $2,711,107 in 1938, owing almost entirely to increased output of zinc-lead ore from the Triumph and North Star mines in the Warm Springs district operated by Snyder Mines, Inc. In 1938 the company shipped 103,746 tons of zinc-lead ore to flotation plants at Bauer and Tooele, Utah, compared with about 68,000 tons in 1937; in addition, 2,380 tons of siliceous ore from the Triumph mine were shipped in 1938 for smelting. Aside from the four chief districts in the Coeur d'Alene region, the Warm Springs district was by far the most important producing area in Idaho. The Triumph mine ranked second in output of zinc in Idaho in 1938, fourth in lead, and sixth in silver. Other producers in Blaine County in 1938 included the Jupiter & Garfield property in the Little Wood River district; the Treasure Vault, Bellevue, Red Elephant, Gold Bottom, Red Leaf, Happy Day, Daisy, Champlain, and Red Rock mines in the Mineral Hill district; and the Vienna mine in the Sawtooth district.

BOISE COUNTY

Boise Basin district (*Centerville, Placerville, Idaho City, Pioneerville, Quartzburg*).—The Boise Basin district continued in 1938 to be the chief gold-producing area in Idaho. Four floating bucket dredges treated 4,236,665 cubic yards of gravel in 1938 and recovered 18,549 ounces of gold, compared with 17,438 ounces in 1937. The Fisher-Baumhoff Co., which operated two bucket dredges (one equipped with seventy 2½-cubic foot buckets and the other with eighty 6-cubic foot buckets) near Centerville, was again the largest producer of gold in the State. Other large producers included the Moores Creek Dredging Co. operating a dredge equipped with seventy-two 7½-cubic foot buckets at Idaho City, the Grimes Co. operating a dredge equipped with seventy-two 3½-cubic foot buckets at Pioneerville, and the Lord & Bishop Co.

operating a 3-cubic yard dragline and floating washing plant on Fall Creek. Considerable gold was recovered by hydraulic mining at the Leary-Brogan, Gold Hill, Packer, and Morning Star properties. The lode output of the district in 1938 was chiefly gold ore from the Mayflower and Gold Hill & Iowa properties. The Texas-Owyhee Mining & Development Co. operated the Mayflower mine near Placerville continuously and treated 19,712 tons of gold ore by flotation concentration. Talache Mines, Inc., operated the Gold Hill & Iowa mine the first 5 months of the year and treated 9,985 tons of gold ore by amalgamation, a decided decrease from the 31,563 tons treated in 1937; the mine was closed in May 1938 and the staff transferred to the company mine at Atlanta, Elmore County. The Come Back Mining Co. operated its mine at Pioneerville throughout 1938 and shipped high-grade gold-silver ore to a smelter. Most of the remainder of the district lode output was gold ore from the Hay Fork, Mountain Chief, Enterprise-Baby, and Mascot mines. Other producing lode mines in Boise County in 1938 included the Birthday mine on Eight Mile Creek; the Grandview, Homestake, Koon Dog, and K. C. mines near Grimes Pass; the Packer John property in the North Fork district; the Golden Cycle and Jessie mines in the Summit Flat district; and the Comeback mine in the West View district. The marked decrease in output from the Summit Flat district was due to suspension of operations by the Golden Cycle Mining Corporation late in 1937.

BONNER COUNTY

Most of the output from Bonner County in 1938 was lead-silver ore, concentrated by flotation, from the Hope (Elsie K.) and Whitedelf properties in the Pend d'Oreille district. The output of ore from the Hope mine was less than half that in 1937, but the output from the Whitedelf increased. Rich silver ore from the Brown Bear, Katherine, Nameloc, and Talache mines, all also in the Pend d'Oreille district, was shipped to a smelter. The output from the Lakeview district decreased decidedly as the Keep Cool mill was not operated; the entire output was mill cleanings from former operations.

BONNEVILLE COUNTY

The metal output of Bonneville County in 1938 was chiefly placer gold recovered by hydraulic and sluicing operations at the McCoy Creek, Rosanna, and James properties in the Mt. Pisgah district.

BOUNDARY COUNTY

Virtually all the output of Boundary County in 1938 was lead-silver ore from the Idaho Continental mine in the Port Hill district; several thousand tons of ore were treated in a 50-ton flotation plant.

BUTTE COUNTY

The output from Butte County in 1938 was crude ore shipped for smelting and comprised silver ore from the Hornsilver and Hub mines in the Lava Creek district and lead ore from the Great Western mine in the Dome district.

CAMAS COUNTY

The increase in output of gold in Camas County in 1938 resulted from operation by the Baumhoff-Fisher Co. of a bucket dredge, equipped with sixty 4-cubic foot buckets, on Little Smoky Creek, and from production of gold ore at the Five Points mine north of Fairfield in the Little Smoky district.

CLEARWATER COUNTY

The output of gold from Clearwater County decreased 1,098 ounces in 1938 owing to suspension of operations at the bucket dredge (64 buckets of 4 cubic feet capacity) on Rhodes Creek, operated in 1937 by Gold Dredging, Inc., and at the dragline and washing plant on Quartz Creek, operated in 1937 by Jett-Ross Mines, Inc. The chief production in the county in 1938 was gold ore from the Silver Creek mine in the Pierce district, where the Silver Creek Gold Mining Co. completed a 50-ton cyanide plant and treated 5,803 tons of gold ore during the latter half of the year. The largest producer of placer gold in the county was the Gold Creek Placer Co., operating a dragline dredge on Orofino Creek in the Pierce district; the dredge operated only a few months.

CUSTER COUNTY

In 1938, as usual, the Bayhorse district was the chief producing area in Custer County, but the value of the district metal output decreased $84,648 from 1937 owing to the decrease in silver from the Ramshorn property that more than offset an increase in silver from the Clayton mine. The Clayton mine and 100-ton flotation mill were operated the entire year by Clayton Silver Mines, and about 39,000 tons of lead ore were milled compared with 28,700 tons in 1937; lead concentrates rich in silver were shipped to Utah for smelting. Silver in crude ore shipped from the Ramshorn mine for smelting decreased nearly 61,000 ounces in 1938. Other producing lode mines in Custer County in 1938 included the White Knob, Bluebird, Ausich, and Horseshoe in the Alder Creek district; the Copper Basin in the Copper Basin district; the Homestake near Stanley; and the Snowdrift, Peak, New Light, and Sunbeam in the Yankee Fork district. Most of the placer output of the county came from Stanley Creek Placers near Stanley and the Gold Bar property in the Yankee Fork district.

ELMORE COUNTY

The value of the metal output from the Middle Boise (Atlanta) district increased from $94,546 in 1937 to $231,439 in 1938. Virtually the entire production came from two properties—the Boise-Rochester mine operated by Talache Mines, Inc., and the Atlanta property operated by the Last Chance Mining Co. Each company treated about 8,000 tons of gold ore by amalgamation and concentration, and each shipped several hundred tons of rich gold ore for smelting. Other producing lode mines in Elmore County in 1938 included the Hunter, Empire, and Big Water in the Bear Creek district; the Homestake and Flat Creek in the Neal district; and the Elk Horn at Pine Grove. The Feather River Placer Mining Co. installed experimental equipment at a placer in the Bear Creek district and treated 21,000 cubic yards of gravel. The Northwest Gold Mining

Co. treated 56,000 cubic yards of gravel from the Rose placer on Snake River near King Hill; the company operated a gas-powered shovel and a special screening and washing plant.

GEM COUNTY

Production of gold in Gem County increased from 759 ounces in 1937 to 4,049 ounces in 1938. Ralph Davis, Inc., the chief producer, operated a dragline and floating washing plant at the Gatfield & Montour property in the West View district. Nearly all the output from lode mines was high-grade gold-silver ore from the Lulu and Black Rock claims.

IDAHO COUNTY

Camp Howard (Salmon River) district (White Bird).—Gold recovered from placer operations in the Camp Howard district increased considerably in 1938. Most of it came from a dragline operation at the Large Bar; other producers included the Pine Bar, Klondyke, Horseshoe Bend Bar, and Olney placers.

Dixie district.—The ¾-cubic-yard dragline dredge at Dixie Placers was idle in 1938, resulting in a decrease in gold production in the Dixie district. Most of the district output was gold ore from the Mammoth mine, concentrated by flotation, and placer gold recovered by dragline dredges at the Salmon River Placer and Alpha properties.

Elk City district.—Production of gold in the Elk City district increased more than 1,000 ounces in 1938 owing to operation of a 1½-cubic-yard dragline and washer at the Marr-Witter property by the American River Mining Co. The company was organized early in the year and became a large producer of gold. Other fairly large producers of placer gold were the Little Million, Columbus, Deadwood, and Gold Hill properties. The Mount Vernon Co. operated its dredge, equipped with sixty-six 2-cubic-foot buckets, a short time at the Deadwood claim and then moved it to a property on upper Crooked River in the Orogrande district. The chief producers of lode gold were the Grangeville and Madre d'Oro mines.

Florence district.—Nearly the entire output of the Florence district in 1938 was placer gold; the largest producer was the Meadow Creek claim, operated by a dragline dredge.

Marshall Lake district (Burgdorf).—The most important metal production in the Marshall Lake district in 1938 was gold recovered from gold ore at the Golden Anchor mine. The Golden Anchor Mining Co. operated the mine the entire year and treated 10,432 tons of ore in a 50-ton amalgamation and flotation plant; it was the largest producer of lode gold in the State, but its output was less than in 1937. Placer operators in the district recovered 222 fine ounces of gold in 1938; the chief producers were the Laughing Water, Idaho Klondike, Golden Rule, and Mary Jane claims.

Newsome district.—The output of gold in the Newsome district was 4,743 ounces in 1938, compared with 832 ounces in 1937. The large gain resulted from steady operation of the dragline and washing plant on Newsome Creek by Ferris & Marchbank (Newsome Creek Mining Co.); the dredge treated 634,933 cubic yards of gravel from April 5 to November 30 and ranked fifth in the State as a gold producer.

Orogrande district.—Production of gold from lode mines in the Orogrande district decreased in 1938 but that from placers increased.

The Orogrande-Frisco Gold Mines, Inc., continued to be the largest producer of gold in the district; it treated 105,983 tons of low-grade gold ore in a 500-ton cyanide plant and recovered 1,917 fine ounces of gold and 1,076 fine ounces of silver. The district output of placer gold (397 ounces) was recovered chiefly by bucket dredging by the Mount Vernon Mining Co. (capacity of dredge given under Elk City district) and sluicing operations at the Baker Gulch property.

Ramey Ridge district.—The value of the metal output of the Ramey Ridge district increased to $99,708 in 1938 owing to the large gain in output of gold ore from the Snow Shoe mine north of Big Creek. The Pierce Metals Development Co. operated the mine throughout the year and treated 5,238 tons of ore in a 25-ton concentration plant; the entire plant was destroyed by fire in January 1939. Nearly all the remainder of the district output was gold ore from the Hand property, treated by amalgamation.

Robbins (Buffalo Hump) district.—The operation of the St. Louis mine by lessees resulted in a large increase in production of gold in the Robbins district in 1938; several thousand tons of gold ore from the mine were treated by concentration at a custom mill at Elk City. The remainder of the district output was chiefly old tailings (gold) from the Jumbo dump, treated by cyanidation.

Salmon River (Riggins and French Creek) district.—Placer operations at Riggins and French Creek recovered 229 fine ounces of gold and 48 fine ounces of silver in 1938; the chief producer was the Morland Gold Corporation, operating the Shorts Bar at Riggins with hydraulic and sluicing equipment.

Ten Mile district (Golden).—The value of the metal output of the Ten Mile district increased from $56,001 in 1937 to $137,145 in 1938 owing to gains in output of gold from the Lone Pine and Blackbird lode mines and the Lena B-Komo placer. The Lone Pine mine was operated throughout the year and was again the largest producer in the district; about 8,000 tons of ore were treated by amalgamation and concentration. The Clearwater Mining Co. was organized early in the year to operate the Blackbird property, and from February 1 to December 22 about 5,000 tons of ore were treated by amalgamation and concentration. Dragline dredging operations at the Lena B-Komo placer were conducted from April 20 to August 7 by the Western Gold Corporation; the company treated 186,494 cubic yards of gravel and recovered 698 fine ounces of gold and 136 fine ounces of silver. The 2-cubic yard dragline and washing plant were moved in August to a property in Oregon. Most of the remainder of the district output was gold ore from the Shamrock, Red Wing, and Gold King mines.

Warren district.—The value of the metal output of the Warren district increased from $248,027 in 1937 to $300,889 in 1938; the chief production was placer gold recovered by two bucket dredges. The Warren Dredging Co. operated its dredge, equipped with seventy-five 3½-cubic foot buckets, nearly all of 1938 and treated 1,015,000 cubic yards of gravel; the company ranked fourth in Idaho as a gold producer. A dredge of the same size as the Warren dredge was operated by the Baumhoff-Fisher Co.; it treated 608,000 cubic yards of gravel from April 20 to November 11 and recovered 2,022 fine ounces of gold and 722 fine ounces of silver. Production of gold from lode mines in the district came chiefly from the Rescue and Little Giant (Unity) properties.

JEROME COUNTY

The metal output of Jerome County in 1938 was placer gold and silver recovered by various operators along the banks of Snake River near Jerome and Murtaugh.

LEMHI COUNTY

Blue Wing district.—In 1938, as in 1937, the entire output of the Blue Wing district was tungsten ore, containing appreciable silver, copper, and lead, from the Ima mine at May. The capacity of the mill was enlarged to treat 150 tons of ore a day, and a new Diesel compressor plant was installed; 26,823 tons of ore were treated by flotation and magnetic separation.

Boyle and Carmen Creeks district.—The Gibbonsville Mining & Exploration Co. constructed a 150-ton flotation plant at the Silver Star mine in 1938 and treated 2,778 tons of low-grade gold-silver ore.

Eldorado district.—No metal was produced in the Eldorado district in 1938, as the Ranger property, a large producer of gold in 1937, was not productive.

Eureka district.—Most of the output from the Eureka district in 1938 was gold ore from the Queen of the Hills mine, treated by amalgamation, and gold ore from the Starlight mine, shipped for smelting.

Gibbonsville district.—Most of the output from lode mines in the Gibbonsville district in 1938 was gold ore from the Twin Brothers mine, treated by concentration; nearly all the placer production was recovered by hydraulic and sluicing operations at the Sundown property by North Fork Placers.

McDevitt district.—All the output of the McDevitt district in 1938 was gold ore and old tailings from the Copper Queen property, treated by concentration; the Tendoy Copper Queen Syndicate operated the mine throughout the year and in December completed the construction of a new 50-ton flotation plant.

Mackinaw district.—Virtually the entire output from lode mines in the Mackinaw district in 1938 was gold ore from the Shoo Fly mine, treated by amalgamation and concentration. The chief placer producers were the K. G. W., Beaver Creek, and Richardson claims.

Mineral Hill district.—Production of gold in the Mineral Hill district was 2,238 ounces in 1938 compared with 245 ounces in 1937. The large gain was due to operation of the Grunter mine and to the increase in output of gold ore from the Gold Hill mine, both at Shoup. The Grunter mine was acquired in January by Gold Producers, Inc., and 6,725 tons of gold ore were treated during the year in the 50-ton flotation mill, formerly used to treat ore from mines at Gibbonsville but moved to Shoup in August; the mine was the largest producer of gold in Lemhi County in 1938. The Gold Hill mine and 100-ton flotation mill were leased in July by I. D. Theriault, and 3,650 tons of gold ore were treated by amalgamation and concentration.

Pratt and Sandy Creeks district.—The large increase in output of gold ore from the Goldstone mine on Pratt Creek resulted in a gain in the district gold production in 1938. The mine was operated the entire year by the Goldstone Mining Co., and several thousand tons of ore were treated by concentration. Gold ore was produced also from the Gem, Mendota, and Gray Eagle mines.

Texas district.—The value of the metal output of the Texas district decreased from $111,373 in 1937 to $33,398 in 1938 owing to the decline in shipments of lead-silver ore from the Silver Moon and Latest Out mines.

Yellow Jacket district.—Most of the output from the Yellow Jacket district in 1938 was gold ore from the Yellow Jacket mine, treated by concentration. The mine was operated under lease by the Treasure Gold Mining Co.; late in the year it was taken over by the Condor Gold Mining Co., controlled by the International Smelting & Refining Co.

NEZ PERCE COUNTY

The entire metal output of Nez Perce County in 1938 was placer gold and silver recovered by various operators along the banks of Salmon and Snake Rivers.

OWYHEE COUNTY

Carson district (*Silver City, De Lamar*).—There were large increases in production of gold in the Carson district in 1938 from both lode and placer properties; the chief output was placer gold recovered by two dredges near De Lamar. Jordan Creek Placers operated its dredge, equipped with sixty-two 3-cubic foot buckets, nearly all the year and treated 605,510 cubic yards of gravel; it was again the largest producer of gold in Owyhee County. Considerable gold was recovered also on Jordan Creek by De Lamar Placers, which operated a dragline and washing plant from March 23 to December 14 and treated 560,000 cubic yards of gravel. The increase in output of lode gold and silver resulted from milling operations at the Trade Dollar and Golden Sunday mines and the De Lamar old tailing dumps; the largest production was derived by concentration of several thousand tons of old tailings from the De Lamar dumps.

Snake River district.—Placer gold recovered from Snake River bars near Grand View decreased in 1938 owing to suspension of operations at the dragline dredge of the Triangle Construction Co. The chief producers were the Dollar claim near Hammett and the Murphy and Hightower claims at Grand View.

POWER COUNTY

Production of gold in Power County was small in 1938, as the dragline dredge, which operated at Bonanza Bar on Snake River in 1937, was idle in 1938.

SHOSHONE COUNTY

COEUR D'ALENE REGION

The value of the metal output of the Coeur d'Alene region decreased 31 percent in 1938. Most of the loss was in lead and zinc production and was due chiefly to suspension of operations at the Morning mine of the Federal Mining & Smelting Co. for 3 months during the summer and to closing of the Star mine of the Sullivan Mining Co. in July. The output of silver also decreased considerably owing to marked decreases at both the Sunshine and Crescent mines. The closing of the lead smelter at East Helena, Mont., for several months in the summer and fall resulted in shut-downs at several Coeur d'Alene properties, and declining prices of lead and zinc caused curtailment by nearly all the large producers of zinc-lead ore. About 58 percent of the material produced in Shoshone County in 1938 was zinc-lead ore, 27 percent silver ore, and 14 percent lead ore. The following table gives production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region in 1937 and 1938 and the total for 1884 to 1938.

Mine production of gold, silver, copper, lead, and zinc in the Coeur d'Alene region, Shoshone County, 1937–38, and total, 1884–1938, 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*	
1937	49	38	1,731,801	3,659	18,457,726	3,888,157	193,010,644	94,140,000	$32,3[illegible],311
1938	43	20	1,514,278	4,053	17,325,379	3,765,795	164,547,979	63,874,125	22,34[illegible],[illegible]13
Total, 1884–1938			(1)	366,164	342,066,466	[2] 49,541	[2] 4,866,152	[2] 636,899	854,563,[illegible]02

[1] Figures not available.
[2] Short tons.

Beaver district.—The value of the metal output of the Beaver district declined from $344,534 in 1937 to $34,701 in 1938, owing chiefly to the large decrease in output of zinc-lead ore and old tailings from the Interstate-Callahan property, where operations were suspended in February after 3,900 tons of zinc-lead ore had been mined; the ore was treated in the Galena mill near Wallace.

Coeur d'Alene district.—Placer gold continued in 1938 to be the chief metal produced in the Coeur d'Alene district, but the output was less than in 1937; most of it was recovered by drift mining at the Beehive Bar, Grove Walker, and Old Dunn claims.

Eagle district.—Production of silver, lead, and zinc in the Eagle district in 1938 was about double that in 1937 owing to increase in output of zinc-lead ore and lead ore from the Jack Waite mine, the only producer. The property lies in both Shoshone County, Idaho, and Sanders County, Mont.; the output from the Idaho section of the mine comprised 7,795 tons of zinc-lead ore treated in the mill at Duthie and 221 tons of rich lead ore shipped for smelting.

Evolution district.—The value ($8,741,743) of the metal production of the Evolution district in 1938 was larger than that of any district in Idaho, although it was $1,789,309 less than in 1937. The chief production, as in 1937, was silver ore from the Sunshine and Polaris properties. The Sunshine Mining Co. was again the largest producer of silver in the United States; the company operated its 1,100-ton flotation mill continuously and treated 321,605 tons of silver ore, or 65,805 tons more than in 1937, but the output of silver declined from 12,152,000 ounces in 1937 to 11,352,154 ounces in 1938 as the silver content of the ore decreased. Development in 1938 comprised 8,695 feet of drifting, 2,198 feet of diamond drilling, 4,446 feet of raising, 3,038 feet of crosscutting, and 434 feet of sinking. The Polaris Mining Co. operated its 200-ton flotation mill throughout the year and treated 64,405 tons of silver ore, or about double the quantity in 1937; the company ranked third in Idaho in production of silver. The remainder of the district output comprised 1,220 tons of silver ore from the Mineral Point mine and 180 tons of ore from the St. Elmo property.

Hunter district (Mullan).—The value of the metal output of the Hunter district declined from $7,691,893 in 1937 to $4,246,649 in 1938; production of silver decreased 337,099 ounces, lead 15,639,814 pounds, and zinc 15,260,683 pounds. These losses were due to decreases in output of ore from the four chief producers—the Morning, Star, Gold Hunter, and Golconda mines. The Morning mine, the largest producer of zinc in the State, was closed from June 25 to September 21, and the Star mine, a large producer of zinc and lead, was closed in July. The output of the Morning mine comprised 262,329 tons of zinc-lead-silver ore concentrated by flotation (compared with 350,609 tons in 1937) and 621 tons of first-class lead-silver ore smelted. The 800-ton flotation plant at the Star mine treated 42,015 tons of zinc-lead ore from the Star mine and 85,241 tons of zinc-lead ore from the Hecla mine. Lessees operated the Gold Hunter mine throughout the year and treated about 34,000 tons of lead-silver ore in the 500-ton flotation plant owned by Gold Hunter Mines, Inc. The 250-ton flotation plant at the Golconda mine was used to treat zinc-lead ore (about 3,900 tons) from the Golconda mine and old tailings (7,570 tons), containing chiefly zinc and lead, deposited on various properties by canyon streams.

Lelande district (Burke, Mace, Frisco).—The value of the metal output of the Lelande district declined 30 percent in 1938. The Hecla mine was, as usual, the largest producer of silver and lead in the district, although its output of ore decreased from 250,630 tons in 1937 to 231,848 tons in 1938. The 750-ton concentration plant at the mine was closed during the summer, and extensive alterations were made to convert the plant to a straight flotation mill; during the reconstruction period zinc-lead ore from the Hecla mine was treated in the Star mill. The output of the mine comprised 133,324 tons of lead ore concentrated, 85,241 tons of zinc-lead ore concentrated, and 13,283 tons of first-class lead-silver ore smelted. The Frisco property was operated throughout the year by the Hull Leasing Co.; it was the largest producer of zinc in the district. The company treated 26,500 tons of zinc-lead ore in a 100-ton flotation plant. The Sherman Lead Co., a large producer of lead-silver ore in 1937, suspended operations in June 1938, resulting in a substantial decrease in the yield of lead and silver. The remainder of the district output was largely old tailings (4,008 tons), containing chiefly zinc and lead, concentrated at the Golconda mill.

Placer Center district.—There were large decreases in output of zinc and lead in the Placer Center district in 1938 owing to curtailment of operations at the Tamarack mine. While the mine was operated (January to May and November and December), 7,300 tons of zinc-lead ore were treated in the Hercules custom mill. Nearly all the remainder of the district output was lead-silver ore (7,007 tons) from the Dayrock property, concentrated in the Hercules mill; the property was operated throughout the year by the Dayrock Mining Co.

Summit district (Murray).—The value of the metal output of the Summit district increased from $19,679 in 1937 to $56,736 in 1938, owing chiefly to the increase in output of gold ore from the Idaho Mother Lode and Golden Chest mines. The ore from both properties (about 5,900 tons) was treated in the 100-ton flotation plant owned by Idaho Mother Lode Gold Mines, Inc. The Golden Chest mine was operated by Consolidated Gold Mines, Inc. The remainder of the district output was chiefly placer gold produced by Nugget Gulch Placers.

Yreka district (*Kellogg*).—The value of the metal output of the Yreka district decreased 34 percent in 1938. The Bunker Hill & Sullivan Mining & Concentrating Co. was, as usual, the most important mining enterprise in Idaho; it ranked first in output of lead, second in silver, and third in zinc. Operations were continuous throughout 1938 at both the Bunker Hill & Sullivan and Crescent properties, but production declined considerably—zinc-lead ore from the Bunker Hill & Sullivan mine from 388,588 tons in 1937 to 347,315 tons in 1938 and silver ore from the Crescent mine from 30,535 to 26,267 tons. There were marked decreases in silver output from the Crescent mine and in zinc and lead from the Bunker Hill & Sullivan mine. The company reported 10,238 feet of development at the two properties in 1938. The Federal Mining & Smelting Co. operated throughout the year at the Page and Blackhawk mines; zinc-lead ore (71,508 tons from the Page and 11,387 tons from the Blackhawk) was treated in the flotation plant at the Page mine. The capacity of the mill was increased to 450 tons a day. Other producers in the Yreka district in 1938 included the Caledonia, Sidney, and Sierra Nevada mines.

TWIN FALLS COUNTY

The entire output of Twin Falls County in 1938 was placer gold and silver recovered by various operators along the banks of Snake River near Twin Falls, Kimberly, and Hansen.

VALLEY COUNTY

Deadwood Basin district.—Nearly all the output of the Deadwood Basin district in 1938 was lead-silver ore from the Lost Pilgrim mine and gold ore from the W. J. L. claim. The Lost Pilgrim mine had been idle since 1932.

Pistol Creek district.—The Lucky Boy mine near Landmark was the only producer in the Pistol Creek district in 1938; 348 tons of lead ore rich in gold and silver were shipped to a smelter in Utah.

Thunder Mountain district.—Most of the output from the Thunder Mountain district in 1938 was gold ore from the Sunnyside mine operated by the Thunder Mountain Mining & Milling Co.; about 3,600 tons of gold ore were treated by amalgamation and concentration.

Yellow Pine district.—The Meadow Creek property near Stibnite was operated by the Yellow Pine Co. until August 1, 1938, and the remainder of the year by the Bradley Mining Co.; all assets of the Yellow Pine Co. were acquired by the Bradley Mining Co. the first of August. The 200-ton flotation mill was operated throughout the year on ore containing chiefly gold, antimony, and silver, but production of gold and silver was much less than in 1937.

WASHINGTON COUNTY

The output from mines in Washington County in 1938 was virtually the same as in 1937, as shipments of silver ore containing lead and copper were maintained from the Silver Still property near Mineral.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN MONTANA

(MINE REPORT)

By T. H. Miller and Paul Luff

SUMMARY OUTLINE

The value of the metal output from mines in Montana decreased 52 percent in 1938 compared with 1937, owing to curtailment in output of copper ore and zinc-lead ore and to lower average prices of silver, copper, lead, and zinc. The output of gold increased slightly, because of regular operations at cyanidation mills, but the output of silver, copper, lead, and zinc decreased markedly. The Anaconda Copper Mining Co. operated the copper mines at Butte at a greatly reduced rate in 1938, and the zinc mines of the company were virtually nonproductive. The output of base ores in Silver Bow, Granite, Jefferson, and Sanders Counties decreased, but the output of gold ore in several counties increased substantially.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] $0.64646464.

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Mine production of gold, silver, copper, lead, and zinc in Montana, 1934–38, and total, 1862–1938, 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
1934	583	654	1,066,952	97,445.95	$3,405,736	4,006,468	$2,590,040
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
1862–1938	--------	--------	(1)	15,897,268.00	340,857,592	679,367,364	497,429,579

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	63,265,000	$5,061,200	20,010,000	$740,370	61,442,256	$2,642,017	$14,439,363
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
1862–1938	[2] 5,685,203	1,678,770,584	[2] 566,392	60,224,372	[2] 1,551,571	235,439,872	2,812,721,999

[1] Figures not available.
[2] Short tons.

Gold and silver produced at placer mines in Montana, 1934–38, in fine ounces, in terms of recovered metals

Year	Sluicing and hydraulic		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
1934	5,607.71	686	4,877.79	889	15,058.39	1,562	25,543.89	3,137
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

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

Gold.—The output of gold in Montana in 1938 increased 1,061 ounces over 1937 (gold from lode mines increasing 2,110 ounces but gold from placer mines decreasing 1,049 ounces). Gold production in Madison County increased 19,395 ounces, owing chiefly to increased output of gold ore at the West Mayflower, Revenue, and Victoria mines. Gold output from Beaverhead and Broadwater Counties also increased, but large decreases were noted in Granite, Silver Bow, Park, Phillips, Jefferson, Deer Lodge, Powell, and Lewis and Clark Counties. There was a marked increase in yield of gold from the Butte Highlands property southeast of Butte, but this gain was more than offset by decreases in gold from both the copper and zinc mines at Butte. Large decreases also in gold output were reported at the Jardine mine in Park County, the Ruby Gulch and Little Ben mines in Phillips County, and the Spring Hill mine near Helena. Several new placer operations were started during 1938, including the new Yuba dredges of Winston Bros. on Prickly Pear Creek and Perry-

Schroeder Mining Co. on Hauser Lake and the dragline and washer plants of Ralph E. Davis Syndicate on Grasshopper Creek, Kit Carson Placers on Lowland Creek, and Norman Rogers Mining Co. on Elk Creek; but gains from these plants were more than offset by losses due to suspension of operations on Clancey Creek by the Humphreys Gold Corporation. The lead smelter at East Helena was closed for more than 3 months during the summer, and the copper plant at Anaconda was closed to shippers of siliceous ores during part of the year. As a result, many shippers of siliceous ores and concentrates were forced to suspend operations during part of 1938, and the gold output

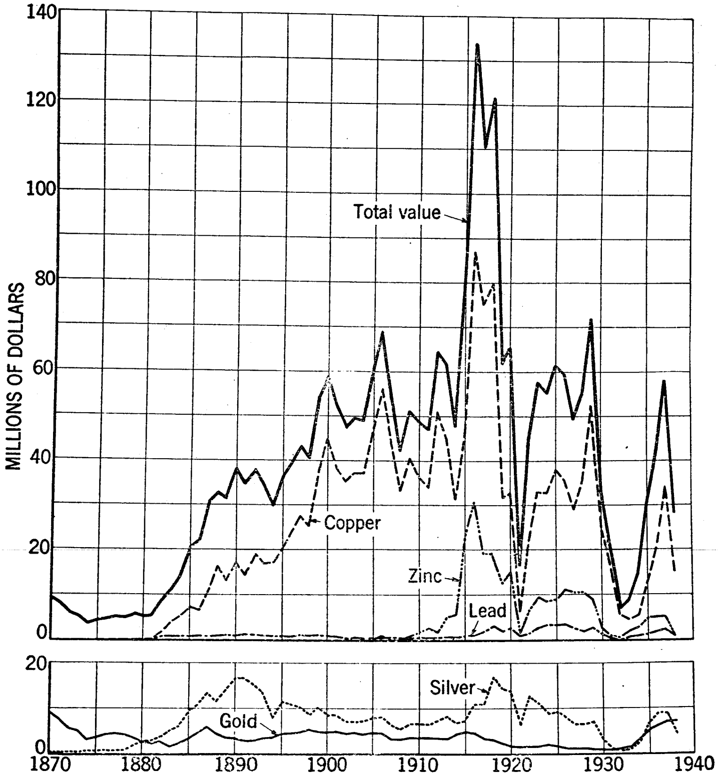

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Montana, 1870–1938.

in many mining districts decreased. The output of gold ore, which yielded 75 percent of the State gold, increased from 644,596 tons in 1937 to 756,223 tons in 1938; the 1938 output comprised 433,233 tons treated at cyanidation plants (310,979 tons in 1937), 77,478 tons treated at amalgamation plants, 190,709 tons treated at concentration plants, and 54,803 tons shipped crude to smelters. The West Mayflower mine in the Renova district, Madison County, was the largest producer of gold in Montana in 1938; other large producers were the Ruby Gulch mine at Zortman, Porter Bros. dredge at Helena, the Butte Highlands mine southeast of Butte, and the Golden Messenger mine at York.

Silver.—The output of silver in Montana in 1938 decreased 46 percent in quantity and 55 percent in value from 1937, owing chiefly to suspension of mining of zinc-lead ores and curtailment in mining of copper ores at Butte by the Anaconda Copper Mining Co. Silver from Silver Bow County decreased 4,053,327 ounces. The zinc concentrator at Anaconda was closed nearly all the year, causing a marked decrease in silver from custom shippers to the mill from mines near Philipsburg in Granite County (silver from Granite County decreased 1,013,138 ounces). Silver from the Flathead mine of the Anaconda Copper Mining Co. was slightly less than in 1937. There were decreases in silver output in Jefferson and Lewis and Clark Counties, but increases were reported from Cascade and Madison Counties. Copper ore yielded 60 percent of the State total silver, silver ore 23 percent, zinc-lead ore 7 percent, and gold ore 6 percent. Nearly 74 percent of the total silver came from ore concentrated and 24 percent from crude ore shipped for smelting. The output of silver ore decreased from 246,325 tons in 1937 to 150,930 tons in 1938. In addition to the copper mines at Butte and the Flathead mine (all operated by the Anaconda Copper Mining Co.), the Comet mine near Basin, the Trout, Granite Bimetallic, Two Percent, and Silver Prince mines near Philipsburg, and the Big Seven and Florence mines near Neihart were important silver producers.

Copper.—The output of recoverable copper in Montana in 1938 decreased 47 percent in quantity and 57 percent in value from 1937. The Anaconda Copper Mining Co. was, as usual, the only important copper producer in the State; its mines at Butte, however, were operated at a greatly reduced rate during 1938, and the quantity of copper ore sent to the mill at Anaconda decreased from 3,068,665 to 1,561,186 tons. The sand-leaching plant at Anaconda was not operated in 1938 (in 1937 it treated 307,014 tons of old tailings by a combination of leaching and flotation concentration). Copper from mine-water precipitates also decreased.

Lead and zinc.—Marked decreases were recorded in output of recoverable lead and zinc in Montana in 1938 compared with 1937; lead decreased 48 percent in quantity and 60 percent in value, and zinc 77 percent in quantity and 83 percent in value. Most of the decrease in both metals can be ascribed to reduced activity in the Butte district, normally the chief producing area. The zinc mines of the Anaconda Copper Mining Co. were closed throughout the year, except for development that produced a limited quantity of zinc-lead ore, and the Emma mine was productive in January only; as a result, the output of zinc-lead ore from Silver Bow County dropped to 9,894 tons in 1938. The zinc concentrator at Anaconda was closed most of the year, and custom receipts from mines near Philipsburg declined to 50,023 tons. Decreases in production of zinc-lead ore were reported also from the Comet mine near Basin and the Jack Waite mine in Sanders County. The Jack Waite, Comet, and Flathead mines were the chief lead producers in Montana in 1938, yielding 73 percent of the State total. Nearly 69 percent of the State total zinc in 1938 came from the slag-fuming plant of the Anaconda Copper Mining Co. at East Helena; the plant was closed during the summer and fall, and the output of both zinc and lead decreased markedly.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, 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	24	8	12,154	$425,390	70,406	$45,515
Broadwater	50	19	10,871	380,485	28,478	18,410
Cascade	9	-------	1,197	41,895	305,893	197,749
Deer Lodge	12	8	3,818	133,630	3,499	2,262
Fergus	6	2	2,769	96,915	3,779	2,443
Flathead	3	-------	640	22,400	521,532	337,152
Granite	41	20	9,532	333,620	595,502	384,971
Jefferson	65	15	19,180	671,300	399,120	258,017
Judith Basin	1	-------	38	1,330	12,324	7,967
Lewis and Clark	54	53	34,857	1,219,995	77,984	50,414
Liberty	-------	2	12	420	-------	-------
Lincoln	9	9	2,400	84,000	4,817	3,114
Madison	122	16	50,370	1,762,950	165,098	106,730
Meagher	1	11	365	12,775	71	46
Mineral	1	18	673	23,555	31	20
Missoula	10	15	1,266	44,310	3,267	2,112
Park	7	4	8,229	288,015	6,217	4,019
Phillips	2	4	18,927	662,445	76,660	49,558
Powell	20	29	9,611	336,385	35,371	22,866
Ravalli	3	8	437	15,295	40,248	26,019
Sanders	4	2	108	3,780	35,425	22,901
Silver Bow	38	17	15,147	530,145	4,018,192	2,597,619
Sweet Grass	-------	2	11	385	-------	-------
Toole	-------	3	701	24,535	48	31
	482	265	203,313	7,115,955	6,403,962	4,139,935
Total, 1937	615	406	202,252	7,078,820	11,812,093	9,136,654

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaverhead	60,857	$5,964	320,826	$14,758	-------	-------	$491,627
Broadwater	4,908	481	248,652	11,438	-------	-------	410,814
Cascade	3,786	371	424,065	19,507	-------	-------	259,522
Deer Lodge	1,806	177	-------	-------	-------	-------	136,069
Fergus	204	20	3,000	138	-------	-------	99,516
Flathead	796	78	2,427,000	111,642	-------	-------	471,272
Granite	82,949	8,129	234,435	10,784	852,708	$40,930	778,434
Jefferson	304,398	29,831	3,322,631	152,841	1,209,417	58,052	1,170,041
Judith Basin	2,959	290	565,087	25,994	-------	-------	35,581
Lewis and Clark	18,929	1,855	1,604,630	73,813	12,145,833	583,000	1,929,077
Liberty	-------	-------	-------	-------	-------	-------	420
Lincoln	296	29	59,739	2,748	12,625	606	90,497
Madison	116,367	11,404	233,870	10,758	-------	-------	1,891,842
Meagher	-------	-------	-------	-------	-------	-------	12,821
Mineral	-------	-------	-------	-------	-------	-------	23,575
Missoula	27,735	2,718	739	34	-------	-------	49,174
Park	6,204	608	22,370	1,029	-------	-------	293,671
Phillips	-------	-------	-------	-------	-------	-------	712,003
Powell	990	97	76,152	3,503	-------	-------	362,851
Ravalli	33,969	3,329	93,130	4,284	484,000	23,232	72,159
Sanders	48,990	4,801	8,602,696	395,724	1,100,000	52,800	480,006
Silver Bow	153,709,857	15,063,566	414,978	19,089	1,883,417	90,404	18,300,823
Sweet Grass	-------	-------	-------	-------	-------	-------	385
Toole	-------	-------	-------	-------	-------	-------	24,566
	154,426,000	15,133,748	18,654,000	858,084	17,688,000	849,024	28,096,746
Total 1937	289,056,000	34,975,776	35,914,000	2,118,926	78,336,000	5,091,840	58,402,016

Gold and silver produced at lode mines in Montana in 1938, 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	47, 317	10, 632	70, 307	Meagher	14	24	3
Broadwater	61, 476	10, 012	28, 345	Mineral	35	15	----------
Cascade	37, 033	1, 197	305, 893	Missoula	1, 187	566	3, 202
Deer Lodge	24, 057	3, 792	3, 499	Park	50, 537	8, 013	6, 200
Fergus	30, 128	2, 763	3, 779	Phillips	164, 108	18, 905	76, 660
Flathead	21, 016	640	521, 532	Powell	4, 558	2, 285	34, 534
Granite	94, 800	9, 280	595, 468	Ravalli	18, 490	390	40, 245
Jefferson	102, 050	9, 758	395, 440	Sanders	44, 730	86	35, 425
Judith Basin	780	38	12, 324	Silver Bow	1, 642, 491	15, 021	4, 018, 161
Lewis and Clark	225, 626	24, 018	76, 926				
Lincoln	17, 257	2, 101	4, 800		2, 724, 466	167, 965	6, 397, 428
Madison	136, 776	48, 429	164, 685	Total, 1937	4, 898, 009	165, 855	11, 805, 678

Gold and silver produced at placer mines in Montana in 1938, by counties, in fine ounces, in terms of recovered metals

County	Sluicing and hydraulic		Dry-land dredges [1]		Floating dredges		Total	
	Gold	Silver	Gold	Silver	Gold	Silver	Gold	Silver
Beaverhead	34	1	1, 488	98	--------	--------	1, 522	99
Broadwater	183	13	676	120	--------	--------	859	133
Deer Lodge	26	--------	--------	--------	--------	--------	26	--------
Fergus	6	--------	--------	--------	--------	--------	6	--------
Granite	237	34	15	--------	--------	--------	252	34
Jefferson	55	3	6, 302	2, 547	3, 065	1, 130	9, 422	3, 680
Lewis and Clark	866	77	131	28	9, 842	953	10, 839	1, 058
Liberty	12	--------	--------	--------	--------	--------	12	--------
Lincoln	93	6	206	11	--------	--------	299	17
Madison	104	17	--------	--------	1, 837	396	1, 941	413
Meagher	145	20	196	48	--------	--------	341	68
Mineral	519	29	139	2	--------	--------	658	31
Missoula	700	65	--------	--------	--------	--------	700	65
Park	216	17	--------	--------	--------	--------	216	17
Phillips	22	--------	--------	--------	--------	--------	22	--------
Powell	444	34	270	42	6, 612	761	7, 326	837
Ravalli	47	3	--------	--------	--------	--------	47	3
Sanders	22	--------	--------	--------	--------	--------	22	--------
Silver Bow	126	31	--------	--------	--------	--------	126	31
Sweet Grass	11	--------	--------	--------	--------	--------	11	--------
Toole	28	1	673	47	--------	--------	701	48
	3, 896	351	10, 096	2, 943	21, 356	3, 240	35, 348	6, 534
Total, 1937	2, 989	369	15, 844	4, 249	17, 564	1, 797	36, 397	6, 415

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

The output of both copper ore and zinc-lead ore decreased markedly in 1938 compared with 1937, causing sharp declines in output of silver, copper, lead, and zinc, but the output of gold ore continued to increase. Gold recovered from gold ore increased 21,534 ounces and more than offset the decrease of 14,939 ounces in gold from base ores. Nearly all the increase in output of gold ore was made at mines that recently have been equipped with new or rebuilt cyanidation mills; gold ore treated by cyanidation increased from 310,979 to 433,233 tons. Despite the large decrease in output of base ores from Butte the output of gold in Montana increased slightly in 1938, owing chiefly to regular operations at cyanidation mills.

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 1938, 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	316	756,223	151,831	363,535	201,594	558,860	
Dry and siliceous gold-silver ore	30	7,448	2,179	116,845	31,127	13,488	
Dry and siliceous silver ore	65	150,930	3,896	1,475,625	150,680	856,175	
	[1] 410	914,601	157,906	1,956,005	383,401	1,428,523	
Copper ore	12	1,607,713	4,965	3,859,576	[2] 153,705,293		
Lead ore	68	10,574	1,471	122,203	29,922	5,524,156	
Zinc ore	1	[3] 76,809		9,357		1,419,130	12,126,833
Zinc-lead ore	13	114,769	3,623	450,287	307,384	10,282,191	5,561,167
Total, lode mines	[1] 482	2,724,466	167,965	6,397,428	[2] 154,426,000	18,654,000	17,688,000
Total, placers	265		35,348	6,534			
	747	2,724,466	203,313	6,403,962	[2] 154,426,000	18,654,000	17,688,000
Total, 1937	1,021	4,898,009	202,252	11,812,093	[4] 289,056,000	35,914,000	78,336,000

[1] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[2] Includes 5,563,800 pounds recovered from precipitates.
[3] Current slag fumed.
[4] Includes 9,614,024 pounds recovered from precipitates.

METALLURGIC INDUSTRY

Lode mines in Montana produced 2,724,466 tons of ore and old tailings in 1938 compared with 4,898,009 tons in 1937. The 1938 output comprised 77,478 tons treated at amalgamation mills, 433,233 tons treated at cyanidation mills, 1,976,828 tons treated at concentration mills, 160,118 tons shipped crude to smelters, and 76,809 tons treated at a slag-fuming plant.

Twenty straight cyanidation mills operated in Montana in 1938 and treated 433,233 tons of ore and old tailings, an increase from 310,979 tons in 1937. Twelve of these plants treated 392,307 tons of material containing 67,570 ounces of gold and 198,834 ounces of silver and produced bullion yielding 59,443 ounces of gold and 114,340 ounces of silver, indicating cyanide extractions of 88 percent of the gold and 58 percent of the silver; the 12 plants used 196,866 pounds of 91-percent grade sodium cyanide, 70,038 pounds of zinc dust, and 3,581,351 pounds of lime. Three of them reported the consumption of 1,160 pounds of lead acetate.

Ore treated at concentration mills decreased from 4,167,560 tons in 1937 to 1,976,828 tons in 1938. The 1938 total comprised 190,709 tons of gold ore, 109,546 tons of silver ore, 1,561,804 tons of copper ore, and 114,769 tons of zinc-lead ore.

Details of the treatment of all ores produced in Montana in 1938 are given in the tables that follow.

Mine production of metals in Montana in 1938, 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	77,478	9,492	2,050			
Ore cyanided	433,233	64,759	120,062			
Concentrates smelted [1]	353,378	34,700	4,724,662	145,432,695	11,257,191	5,561,167
Copper precipitates smelted	4,045			5,563,800		
Ore smelted	160,118	59,014	1,541,297	3,429,505	5,977,679	
Slag fumed	76,809		9,357		1,419,130	12,126,833
Placer		35,348	6,534			
		203,313	6,403,962	154,426,000	18,654,000	17,688,000
Total, 1937		202,252	11,812,093	289,056,000	35,914,000	78,336,000

[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 1938, by types of mills and by counties, in terms of recovered metals

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*
AMALGAMATION MILLS								
Beaverhead	75	25	2					
Broadwater	1,671	418	56	40	18	61	7	1,380
Deer Lodge	1,288	162	12					
Granite	300	41	15	3	33	39		
Jefferson	1,899	306	59	34	71	410	1,082	1,978
Lewis and Clark	168	35	25	2	5	24		
Lincoln	17,035	1,806	348	89	285	2,361	296	11,444
Madison	4,103	629	603	116	349	2,110	174	2,604
Missoula	400	115	15	12	20	13		
Park	50,088	5,830	895	1,262	1,819	420		
Powell	416	104	20	41	39	249		2,752
Ravalli	35	21						
	77,478	9,492	2,050	1,599	2,639	5,687	1,559	20,158
Total, 1937	85,039	12,955	2,682	1,459	3,633	12,861	576	25,000
CYANIDATION MILLS								
Beaverhead	41,201	9,176	6,156					
Deer Lodge	22,190	3,316	348					
Fergus	30,006	2,758	1,454					
Granite	24,139	4,674	152					
Jefferson	8,037	228	31					
Lewis and Clark	86,652	14,713	40,637					
Madison	39,517	4,828	4,240					
Phillips	163,506	16,217	66,023					
Silver Bow	17,985	8,849	1,021					
	433,233	64,759	120,062					
Total, 1937	310,979	50,582	117,956					
Grand total: 1938	510,711	74,251	122,112	1,599	2,639	5,687	1,559	20,158
1937	396,018	63,537	120,638	1,459	3,633	12,861	576	25,000

Mine production of metals from concentrating mills in Montana in 1938, 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	57,313	5,982	6,820	3,872	1,880	44,100	----------
Cascade	36,927	1,254	1,056	289,099	3,524	408,939	----------
Granite	48,494	2,259	883	245,058	26,962	199,753	852,708
Jefferson	81,780	12,731	5,069	326,596	258,024	2,964,174	1,209,417
Lewis and Clark	56,586	2,772	5,607	6,915	8,863	138,430	19,000
Lincoln	108	32	----------	309	----------	19,947	12,625
Madison	62,682	3,394	8,183	11,983	92,912	----------	----------
Ravalli	17,850	721	151	35,920	7,778	93,130	484,000
Sanders	43,390	5,739	74	29,524	41,428	6,959,995	1,100,000
Silver Bow	1,571,698	316,895	4,218	3,769,699	144,989,765	408,565	1,883,417
	1,976,828	351,779	32,061	4,718,975	145,431,136	11,237,033	5,561,167
Total, 1937	4,167,560	653,919	46,391	9,634,934	274,457,499	27,206,506	57,676,000

Gross metal content of concentrates produced from ore mined in Montana in 1938, 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	13,015	17,406	19,816	24,688	162,878	----------
Dry silver	1,554	1,821	304,699	6,966	64,900	----------
Copper	316,099	9,130	3,727,614	148,207,241	----------	----------
Lead	9,977	3,938	496,220	239,712	10,895,692	520,469
Zinc	5,826	369	120,200	98,973	354,223	6,178,733
Iron (from zinc-lead ore)	6,907	2,036	56,113	69,324	262,382	982,961
	353,378	34,700	4,724,662	148,646,904	11,740,075	7,682,163
Total, 1937	655,378	50,024	9,647,795	284,546,967	28,734,876	68,834,160

Mine production of metals from Montana concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Broadwater	6,022	6,838	3,933	1,887	45,480	----------
Cascade	1,254	1,056	289,099	3,524	408,939	----------
Granite	2,262	916	245,097	26,962	199,753	852,708
Jefferson	12,765	5,140	327,006	259,106	2,966,152	1,209,417
Lewis and Clark	2,774	5,612	6,939	8,863	138,430	19,000
Lincoln	121	285	2,670	296	31,391	12,625
Madison	3,510	8,532	14,093	93,086	2,604	----------
Missoula	12	20	13	----------	----------	----------
Park	1,262	1,819	420	----------	----------	----------
Powell	41	39	249	----------	2,752	----------
Ravalli	721	151	35,920	7,778	93,130	484,000
Sanders	5,739	74	29,524	41,428	6,959,995	1,100,000
Silver Bow	316,895	4,218	3,769,699	144,989,765	408,565	1,883,417
	353,378	34,700	4,724,662	145,432,695	11,257,191	5,561,167
Total, 1937	655,378	50,024	9,647,795	274,458,075	27,231,506	57,676,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	13,015	17,406	19,816	20,979	156,363	----------
Dry silver	1,554	1,821	304,699	5,831	62,401	----------
Copper	316,099	9,130	3,727,614	145,042,091	----------	----------
Lead	9,977	3,938	496,220	209,415	10,459,310	----------
Zinc	5,826	369	120,200	94,402	336,505	5,561,167
Iron (from zinc-lead ore)	6,907	2,036	56,113	59,977	242,612	----------
	353,378	34,700	4,724,662	145,432,695	11,257,191	5,561,167

Gross metal content of Montana crude ore shipped to smelters in 1938, 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	54, 803	52, 918	205, 154	84, 247	292, 040
Dry and siliceous gold-silver	7, 448	2, 179	116, 845	32, 135	14, 309
Dry and siliceous silver	41, 384	1, 594	954, 150	100, 527	226, 782
Copper	45, 909	852	142, 945	3, 359, 476	
Lead	10, 574	1, 471	122, 203	36, 167	5, 729, 218
	160, 118	59, 014	1, 541, 297	3, 612, 552	6, 262, 349
Total, 1937	213, 536	52, 294	2, 016, 574	5, 185, 430	6, 593, 547

Mine production of metals from Montana crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Beaverhead	6, 041	1, 431	64, 149	60, 857	320, 826
Broadwater	2, 492	2, 756	24, 356	3, 021	203, 172
Cascade	106	141	16, 794	262	15, 126
Deer Lodge	579	314	3, 139	1, 806	
Fergus	122	5	2, 325	204	3, 000
Flathead	21, 016	640	521, 532	796	2, 427, 000
Granite	21, 867	3, 649	350, 204	55, 987	34, 682
Jefferson	10, 334	4, 084	68, 344	45, 292	356, 479
Judith Basin	780	38	12, 324	2, 959	565, 087
Lewis and Clark	5, 411	3, 658	19, 968	10, 066	47, 070
Lincoln	114	10	1, 782		28, 348
Madison	30, 474	34, 440	145, 749	23, 281	231, 266
Meagher	14	24	3		
Mineral	35	15			
Missoula	787	431	3, 174	27, 735	739
Park	449	364	4, 885	6, 204	22, 370
Phillips	602	2, 688	10, 637		
Powell	4, 142	2, 142	34, 265	990	73, 400
Ravalli	605	218	4, 325	26, 191	
Sanders	1, 340	12	5, 901	7, 562	1, 642, 701
Silver Bow	52, 808	1, 954	247, 441	3, 156, 292	6, 413
	160, 118	59, 014	1, 541, 297	3, 429, 505	5, 977, 679
Total, 1937	213, 536	52, 294	2, 016, 574	4, 983, 901	6, 326, 494

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous gold	54, 803	52, 918	205, 154	79, 750	275, 309
Dry and siliceous gold-silver	7, 448	2, 179	116, 845	31, 127	13, 488
Dry and siliceous silver	41, 384	1, 594	954, 150	96, 392	164, 726
Copper	45, 909	852	142, 945	3, 192, 314	
Lead	10, 574	1, 471	122, 203	29, 922	5, 524, 156
	160, 118	59, 014	1, 541, 297	3, 429, 505	5, 977, 679

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	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	12		33,487	8,319		8,319	9,866		9,866	1,265	100,826		$302,305
Bannack	3	4	10,334	2,150	1,509	3,659	6,008	99	6,107	3,296	2,043		132,430
Big Hole	4	3	103	36	11	47	17		17	500			1,705
Bryant	1		2,654	126		126	41,911		41,911	54,296	217,957		46,851
Vipond	3		722	1		1	12,242		12,242	1,500			8,096
Broadwater County:													
Backer	7	13	156	292	786	1,078	693	130	823	1,510	7,652		38,762
Beaver	11		10,106	2,289		2,289	12,952		12,952	1,786	110,131		93,729
Cedar Plains	14		48,839	6,284		6,284	4,834		4,834	1,408	7,108		223,530
Park	18	5	2,375	1,147	68	1,215	9,866	3	9,869	204	123,761		54,618
Cascade County: Montana	9		37,033	1,197		1,197	305,893		305,893	3,786	424,065		259,522
Deer Lodge County:													
Dry Gulch		3			9	9							315
French Gulch		2			8	8							280
Georgetown	6		23,855	3,768		3,768	546		546	1,010			132,332
Heber	1	2	11	3	7	10	51		51				383
Oro Fino	3		105	21		21	1,383		1,383	112			1,640
Silver Lake	2		86				1,519		1,519	684			1,049
Fergus County:													
North Moccasin	2		30,006	2,758		2,758	1,454		1,454				97,470
Warm Springs	3	2	116	5	6	11	2,311		2,311				1,879
Flathead County: Hog Heaven	3		21,016	640		640	521,532		521,532	796	2,427,000		471,272
Granite County:													
Alps		3			9	9							315
Boulder	5	2	432	129	81	210	1,700	3	1,703	1,245	4,065		8,760
First Chance	23	6	3,477	2,828	47	2,875	3,202	14	3,216	6,735	218		103,374
Flint Creek	5		66,163	1,350		1,350	582,598		582,598	65,704	226,261	852,708	481,656
Gold Creek		3			78	78		14	14				2,739
Henderson	2	1	253	19	15	34	2,622		2,622	4,500			3,326
Maxville	2		197	64		64	5,165		5,165	4,714	3,891		6,220
Red Lion	2		24,181	4,725		4,725	164		164	51			165,486
Rock Creek		3			18	18		3	3				632
Stony	2		97	165		165	17		17				5,786
Jefferson County:													
Amazon	3		63	8		8	478		478	41	2,674		716
Bigfoot	1		20	14		14	116		116	255			590
Boulder	4		84	9		9	2,475		2,475	265	21,565		2,933

Cataract	19	7	42,634	4,268	38	4,306	292,760	3	292,763	224,388	2,651,370	1,209,417	541,976
Clancey	-	4	-	-	7,446	7,446	-	2,540	2,540	-	-	-	262,252
Colorado	7	-	24,176	499	-	499	63,640	-	63,640	49,337	255,152	-	75,178
Elkhorn	10	1	13,670	409	1	410	6,568	-	6,568	1,653	32,870	-	20,270
Homestake	4	-	27	8	-	8	444	-	444	102	2,326	-	684
Lowland	-	3	-	-	1,937	1,937	-	1,137	1,137	-	-	-	68,530
McClellan Creek	1	-	75	22	-	22	3,513	-	3,513	1,020	2,217	-	3,243
Mitchell	3	-	144	175	-	175	396	-	396	653	-	-	6,445
Warm Springs Creek	2	-	14,364	1,692	-	1,692	13,713	-	13,713	21,653	131,587	-	76,260
Whitehall	10	-	4,938	2,293	-	2,293	10,873	-	10,873	3,949	220,892	-	97,832
Wilson Creek	1	-	1,855	361	-	361	464	-	464	1,082	1,978	-	13,132
Judith Basin County: Barker	1	-	780	38	-	38	12,324	-	12,324	2,959	565,087	-	35,581
Lewis and Clark County:													
Cave Gulch	-	4	-	-	30	30	-	-	-	-	-	-	1,050
Dry Gulch	3	6	45,060	7,882	36	7,918	5,575	-	5,575	-	-	-	280,734
Greenhorn	-	6	-	-	35	35	-	-	-	-	-	-	1,225
Helena	14	9	52,824	3,750	9,783	13,533	1,601	939	2,540	643	4,478	-	475,566
Lincoln	2	11	5	3	192	195	3	20	23	-	-	-	6,840
Marysville	15	5	19,563	5,449	147	5,596	14,437	31	14,468	7,980	113,435	-	211,213
Missouri River	-	8	-	-	561	561	-	51	51	-	-	-	19,668
Rimini	6	3	618	144	48	192	11,614	17	11,631	5,214	66,978	19,000	18,743
Scratch Gravel	6	-	456	415	-	415	591	-	591	5,010	-	-	15,398
Smelter	1	-	76,809	-	-	-	9,357	-	9,357	-	1,419,130	12,126,833	653,417
Stemple	5	1	30,284	6,373	7	6,380	33,564	-	33,564	82	457	-	245,027
Liberty County: Corral Creek	-	2	-	-	12	12	-	-	-	-	-	-	420
Lincoln County:													
Cabinet	1	1	1,500	151	2	153	99	-	99	51	457	-	5,445
Libby	2	8	1,509	185	297	482	348	17	365	-	11,152	-	17,619
Sylvanite	3	-	14,106	1,764	-	1,764	2,591	-	2,591	245	15,935	-	64,172
Troy	3	-	142	1	-	1	1,762	-	1,762	-	32,195	12,625	3,261
Madison County:													
Havana	1	-	72	99	-	99	1,830	-	1,830	-	-	-	4,648
Norris	27	2	11,187	8,847	670	9,517	12,409	99	12,508	1,990	85,109	-	345,291
Pony	15	-	63,794	8,602	-	8,602	12,737	-	12,737	93,531	456	-	318,491
Renova	5	-	19,835	18,488	-	18,488	101,639	-	101,639	-	565	-	712,812
Rochester	9	-	722	311	-	311	3,977	-	3,977	1,306	95,087	-	17,958
Sheridan	18	6	1,528	2,417	51	2,468	5,315	14	5,329	3,255	15,305	-	90,848
Silver Star	10	-	34,631	6,460	-	6,460	6,353	-	6,353	14,531	4,761	-	231,850
Tidal Wave	15	-	1,021	1,373	-	1,373	5,544	-	5,544	1,530	25,391	-	52,957
Virginia City	17	7	3,363	1,345	49	1,394	13,266	3	13,269	194	5,239	-	57,628
Washington	4	1	621	487	1,171	1,658	1,468	297	1,765	30	1,957	-	59,264
Meagher County:													
Atlanta Creek	-	1	-	-	19	19	-	3	3	-	-	-	667
Beaver Creek	-	7	-	-	316	316	-	65	65	-	-	-	11,102
Little Belt	1	-	14	24	-	24	3	-	3	-	-	-	842
Mineral County: Cedar Creek	1	18	35	15	658	673	-	31	31	-	-	-	23,575
Missoula County:													
Coloma	8	-	694	536	-	536	464	-	464	541	739	-	19,147
Copper Cliff	1	-	78	14	-	14	31	-	31	3,888	-	-	891
Elk Creek	-	4	-	-	571	571	-	51	51	-	-	-	20,018
Nine Mile	-	11	-	-	129	129	-	14	14	-	-	-	4,524
Wallace	1	-	415	16	-	16	2,707	-	2,707	23,306	-	-	4,594

Mine production of gold, silver, copper, lead, and zinc in Montana in 1938, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	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*	
Park County:													
Crevasse	3		446	61		61	31		31				$2,155
Emigrant Creek		3			213	213		17	17				7,466
New World	3		440	362		362	4,885		4,885	6,204	22,370		17,465
Sheepeater	1		49,651	7,590		7,590	1,284		1,284				266,480
Phillips County: Little Rockies	2	4	164,108	18,905	22	18,927	76,660		76,660				712,003
Powell County:													
Big Blackfoot	2	3	43	65	36	101	82	3	85		304		3,604
Nigger Hill	7	2	791	277	193	470	4,670	31	4,701	816	26,805		20,802
Ophir		1			69	69		3	3				2,417
Pioneer		7			6,764	6,764		772	772				237,239
Race Track Creek	1		25	6		6	3		3				212
Washington Gulch	2	16	13	137	264	401	178	28	206	133	739		14,215
Zozell	8		3,686	1,800		1,800	29,601		29,601	41	48,304		84,362
Ravalli County:													
Curlew	1		18,453	368		368	40,211		40,211	33,969	93,130	484,000	69,720
Overwich	1	8	35	21	47	68		3	3				2,382
Sanders County:													
Eagle	1		44,668	79		79	35,377		35,377	44,296	8,602,696	1,100,000	478,500
Revais Creek	3		62	7		7	48		48	4,694			736
Vermillion		2			22	22							770
Silver Bow County:													
German Gulch		7			66	66		14	14				2,319
Highland	1	3	17,985	8,849	7	8,856	1,021		1,021				310,620
Independence	2		636	27		27	11,668		11,668				8,488
Melrose	4		134	13		13	2,475		2,475		6,413		2,350
Silver Bow Creek		5			48	48		17	17				1,691
Summit Valley	31		1,623,736	6,132		6,132	4,002,997		4,002,997	153,709,857	408,565	1,883,417	17,975,180
Sweet Grass County: Yellowstone River		1			9	9							315
Toole County: Gold Butte		3			701	701		48	48				24,566
Other districts [1]	6	12	34	3	29	32	642		642	204	3,152		1,700
Total Montana	482	265	2,724,466	167,965	35,348	203,313	6,397,428	6,534	6,403,962	154,426,000	18,654,000	17,688,000	28,096,746

[1] Includes 15 districts, each having production valued at less than $200.

In the following review by counties and mining districts, only the more important operations are mentioned. Many small producing mines and districts whose output is included in the foregoing tables are omitted.

BEAVERHEAD COUNTY

Ermont Mines, Inc., continued regular operations in 1938 at the Ermont group of 34 claims in the Montana or Argenta district and was again the chief producer in Beaverhead County; 31,583 tons of ore were treated in the 100-ton cyanidation mill, but the output of gold decreased slightly. The remainder of the district output was crude ore shipped for smelting, including gold ore from the Goldfinch, Ground Hog, Humboldt, and Shafer mines; lead ore from the Iron Mountain, Katherine L., Midnight, Silver Horn, and Blue Moon mines; and silver ore from the Silver Horn and Trout Creek properties.

The value of the metal output from the Bannack district increased from $18,160 in 1937 to $132,430 in 1938, both placers and lode mines contributing to the gain. The Golden Leaf (Sleeping Princess) group of 21 mining claims and the 150-ton cyanidation mill at Bannack (owned by the New York Montana Mines Co.) were operated by the I. B. H. Co. during January and February, and 3,222 tons of ore were milled; later the property was acquired by the Golden Messenger Corporation, and nearly 6,000 tons of ore were cyanided during the last quarter of the year; and, in addition, lessees shipped nearly 700 tons of gold ore for smelting, chiefly from the Priscilla and Wallace claims. The Hendricks (Bannack Apex Mining Co.) and the Gold Crown (Taylor, Nelson & Knapp, Inc.) lode mines also were productive. A group of 14 placer claims on Grasshopper Creek (site of the earliest dredging operations in Montana) were acquired during 1938 by the Ralph E. Davis Syndicate; a dragline and dry-land washer were installed, and 338,372 cubic yards of gravel were treated during the season (June 24 to November 20); nearly 1,500 ounces of gold were produced—by far the most important placer production in Beaverhead County. Other producing lode mines in Beaverhead County included the Hecla mine in the Bryant district (2,654 tons of silver ore and lead ore shipped for smelting) and the Quartz Hill property in the Vipond district (699 tons of silver ore shipped for smelting).

BROADWATER COUNTY

The placer output from the Backer district increased sharply in 1938 owing to the operation of two new dragline dredges in Confederate Gulch—Charles L. Sheridan installed power shovels and a stationary washing plant at the Boulder Bar group and treated about 125,000 cubic yards of gravel, between May 10 and November 12; and A. W. Mylroie (Fairplay Placers, Inc.) operated a dragline and washer, testing ground in Confederate Gulch, and installed heavier equipment early in 1939. The Sheriff placer at the head of Magpie Gulch also was active. Most of the lode production from the district came from the Superior mine; other producing lode mines included the Anna May, Cooper, and Satellite properties.

Gold from lode mines in the Beaver district in 1938 was more than double that in 1937; much of the gain was from the Custer mine near Winston, where the new 60-ton flotation plant was operated regularly; the mine produced 1,011 ounces of gold—nearly half of the district total. The remainder of the district output was crude ore shipped for smelting and comprised gold ore from the Agua Fria, Black Tail, Edna, Homestead, Iron Age, Sullivan, Vosburg, and Emma mines and lead ore from the Martha Washington and Stray Horse mines.

Most of the output from the Cedar Plains district came in 1938, as usual, from the Keating property operated by the C-G Gold Corporation; the mine and 100-ton flotation plant were operated regularly and the output of gold increased nearly 30 percent. The Ohio-Keating property was leased by Walter McLaren during the year, and several thousand tons of gold ore were treated in the 50-ton concentrator at the mine. The remainder of the district output included gold ore shipped for smelting from the Barnato, Black Friday, Donald Dee, Gold Coin, Hard Cash, Iron Age, Keystone, Laura Rae, and North Home mines; silver ore from the Spar property; and lead ore from the Gopher mine.

In 1938 the Marietta mine again was the chief producer in the Park district; the output comprised 266 tons of gold ore and 117 tons of lead ore shipped for smelting. Several hundred tons of ore from the Speculator mine were treated by amalgamation, and ore from the Gold Bug mine was treated by amalgamation and concentration; the remainder of the district lode output was crude ore shipped for smelting and included gold ore from the Blacksmith, Crosscut, Little Joe, Mississippi, and St. Louis mines and lead ore from the Iron Mask, Little Fannie, Park-New Era, Silver Mountain, Springhill, W. A. Clark, and West Park mines. Most of the placer output from the district came from the Wilson property on Indian Creek, operated by S. E. E., Inc.

CASCADE COUNTY

The value of the metal output from Cascade County increased slightly in 1938 despite closing of the lead smelter at East Helena during the summer and fall; several properties suspended operations during the smelter shut-down, and others were forced to ship to lead smelters near Kellogg, Idaho, and Salt Lake City, Utah. All the output of the county came from mines near Neihart in the Montana district. The Montana Silver Queen Mining Co. again was the chief producer in the district; according to the company printed annual report, 13,494 tons of silver ore from the Big Seven group were mined and treated in the 50-ton flotation plant, and 501 tons of rich silver concentrates containing considerable gold and lead were shipped for smelting. The Florence Co. treated 10,108 tons of silver ore from the Florence mine in the 40-ton flotation plant, and Ruby Silver Mines, Inc., milled 5,125 tons of silver ore from the Benton group in a 35-ton flotation plant; silver ore from the Hartley and Silver Belt mines was also milled. The remainder of the output from the Montana district was crude ore shipped for smelting from the Commonwealth, Graham & Hollowbush, and Lucky Strike mines.

DEER LODGE COUNTY

The value of the metal output from the Georgetown district declined 27 percent in 1938, as all the important producers reported decreases. As usual, the chief producer was the Holdfast group operated by Thomas H. Sheridan; 15,400 tons of gold ore were treated in the cyanidation mill, but gold from cyanide precipitates decreased. The Gold Coin Mines Co. treated several hundred tons of gold ore from the Gold Coin mine by amalgamation and several thousand tons of old tailings by cyanidation; the combined output of gold was less than in 1937. The remainder of the district output was gold ore shipped for smelting from the Isabelle and Southern Cross mines. Other production from lode mines in Deer Lodge County comprised siliceous ore shipped for smelting from the Cashier, Champion, and Independence mines in the Oro Fino district and the Cameron and Silver Heart mines in the Silver Lake district; the output of silver ore from the Silver Lake district decreased sharply, as the Silver Reef mine, an important shipper in 1937, was idle.

FERGUS COUNTY

The value of the metal output from Fergus County in 1938 increased 35 percent over 1937, owing to regular operation of the enlarged cyanidation mill at the Barnes-King property in the North Moccasin district; the mine was operated the entire year by the North Moccasin Mines Syndicate, and the output of gold increased 1,062 ounces. A test lot of gold ore from the Dawes & Golden mine, also in the North Moccasin district, was treated by cyanidation. The remainder of the county output comprised lead ore from the Iron Chancellor mine in the Cone Butte district; silver ore from the Argentite, Silver Bell, and Silver Queen mines in the Warm Springs district; and placer gold from the Alpine and Grubstake properties in the Warm Springs district.

FLATHEAD COUNTY

The decrease of $49,607 in the value of the metal output from Flathead County in 1938 was due almost entirely to the lower silver price prevailing, as the output of lead increased 812,000 pounds and that of silver (521,532 ounces) was only slightly less than in 1937. The Flathead mine of the Anaconda Copper Mining Co. in the Hog Heaven district was, as usual, the chief producer; the ouput comprised 15,797 tons of silver ore shipped to the Washoe smelter and 4,997 tons of silver-lead ore shipped to the lead smelter at East Helena. The remainder of the county output was silver ore from the Black Jack and Eudora mines.

GRANITE COUNTY

The value of the metal output from Granite County declined from $2,634,839 in 1937 to $778,434 in 1938, owing chiefly to suspension of mining of zinc-lead ore at properties near Philipsburg. The Trout Mining Division of American Machine & Metals, Inc., operated the zinc-sulfide unit (Trout and Algonquin mines) during January only and produced 3,320 tons of zinc-lead ore compared with nearly 60,000 tons in 1937; the zinc-lead ore was shipped to the custom mill at Anaconda, and in addition the company shipped 7,481 tons of silver ore for smelting. The Silver Prince property of the Contact Mines Corporation was idle during July and August and operated at a reduced rate during the other 10 months of the year; the output was about one-third of that in 1937 and comprised

3,271 tons of crude ore shipped for smelting and 1,260 tons of zinc-lead ore sent to the zinc mill at Anaconda. The Two Percent mine was operated 10 months by Taylor, Nelson & Knapp, Inc.; the output was about one-half of that in 1937 and comprised 6,732 tons of silver ore shipped for smelting and 443 tons of zinc-lead ore sent to the mill at Anaconda. The Philipsburg Mining Co. operated the Granite Bimetallic mine for 10 months and treated 43,471 tons of ore in the 165-ton flotation plant; however, the 1938 output of silver was less than half of that in 1937, owing to suspension of shipments of old tailings.

Lessees continued shipments of crude ore in 1938 for smelting from properties in the First Chance or Garnet district, but the output of gold from the district decreased 929 ounces. Most of the output again came from various claims of the Mitchell-Mussigbrod group. Other producing lode mines included the Climax, Ella May, Gold Leaf, Grant & Hartford, Lady Jane, Laddy Buck, Lynx, Nancy Hanks, Peggy Ann, Pearl, Sierra, T. H., and Tiger mines.

Operations were continued during 1938 at the Hidden Lake property in the Red Lion district; the company (Hidden Lake Venture, Inc.) treated 24,139 tons of ore in the 70-ton cyanidation mill, but the output of gold declined slightly. A car of gold ore was shipped for smelting from the Olympic mine.

Other producing lode mines in Granite County in 1938 included the Blue Bird, Brooklyn, Gold Reef, Sunday, and Tussle properties in the Boulder district; the Black Pine and Sunrise mines in the Henderson district; the Goldonna (Londonderry) and Gold Coin mines near Maxville; and the Nellie and Stevens mines in the Stony district.

Most of the placer output from Granite County in 1938 came from the Montana-Tonopah placer in the Boulder district, the Tibbits & Fowler placer on upper Gold Creek, and the New Deal placer in Henderson Gulch.

JEFFERSON COUNTY

The value of the metal output from Jefferson County decreased 31 percent in 1938, owing chiefly to suspension of operation at the Comet property in the Cataract district. The mine and 150-ton flotation plant operated by the Basin Montana Tunnel Co. were idle during the summer, and the output of zinc-lead ore declined from 65,137 tons in 1937 to 38,170 tons in 1938; lead concentrates and iron concentrates were shipped to East Helena for smelting, and zinc concentrates were sent to the electrolytic plant at Great Falls. The Crystal mine, also in the Cataract district, was operated the entire year by Chester Bullock; the output comprised 1,869 tons of gold-silver ore shipped for smelting and 162 tons of zinc-lead ore shipped to a custom mill at Midvale, Utah. Gold ore from the Gray Lead mine was treated in a small concentrator, and the remainder of the lode output from the district was crude ore shipped for smelting from several properties, including the Boulder, Buckeye & Boston, Bullion, Idler, Jib, Minneapolis, Morning Glory, Rose, Saturday Night, Sirius, Vera, Vindicator, and Virginia mines.

There was a marked decrease in output of placer gold from the Clancey (Prickly Pear Creek, Montana City) district in 1938, owing entirely to suspension of operations on Clancey Creek by the Humphreys Gold Corporation. The company was the largest dragline operator in Montana in 1937, but operations were discontinued November 27, 1937, and the plant was dismantled. This loss was offset in part by a substantial increase in gold production by Winston Bros. Co., which operated the dragline and floating washer 11 months (the plant was idle in February) in 1938 and treated 820,424 cubic yards of gravel; in addition, the company completed erection of a Yuba connected-bucket dredge on Prickly Pear Creek south of Clancey. The new dredge is electrically powered, the digging ladder is equipped with eighty-eight 6-cubic foot buckets, and gold recovery is effected entirely by Pan-American jigs; the new plant was placed in operation August 20, 1938, and treated 587,653 cubic yards of gravel before the end of the year. Nearly all the remainder of the district output came from a dragline and washer on Dutton Ranch, which treated 43,270 cubic yards of gravel from May 25 to December 24.

The Alta property near Wickes in the Colorado district was operated in 1938 from June to December by Eathorne & Fox; the output comprised 23,748 tons of old tailings treated in a 200-ton flotation plant and 40 tons of lead ore shipped for smelting. The remainder of the district output was crude ore shipped for smelting from the Arogon, Blizzard, Blue Bird, Minah, and Minnesota mines.

The value of the metal output from the Elkhorn district decreased $84,438 in 1938 owing to suspension of operations by Elkhorn Metals, Inc. The company stopped operations at the flotation plant treating old tailings from the Elkhorn property late in 1937, and the output in 1938 was mostly clean-up material from previous operations. The J. L. Shiely Co. acquired the Peacock & Moreau property and treated about 8,000 tons of old tailings by cyanidation. Other producers in the district included the C & D, Golden Curry, Golden Moss, Klondyke, Little Goldie, Sophia, and Wildcat properties.

The placer output from the Lowland district increased markedly in 1938 owing to operation of a dragline and washing plant on Lowland Creek by Kit Carson Placers.

The Newburg Mining & Milling Co. continued operations at the Fleming property in 1938; gold ore was treated by flotation, and nearly 1,500 tons of concentrates were shipped for smelting. In addition, 316 tons of crude gold ore were produced.

Mines in the Whitehall district produced in 1938 at about the same rate as in 1937. As usual, the Golden Sunlight mine, operated by the A. O. Smith Corporation and various sublessees, was the chief producer; about 3,400 tons of gold ore were shipped for smelting. The remainder of the district output comprised gold ore from the Leah, Lucky Hit, Pay Day, Saddle Horse, Sunny Corner, and Sunnyside mines and lead ore from the Mary Lucile and Surprise properties.

The output of gold ore from the Callahan mine in the Wilson Creek (Woodland Park) district was considerably less in 1938 than in 1937. The property was operated by the Golden Age Mining Co.; the ore is treated by amalgamation and flotation.

Other producing lode mines in Jefferson County in 1938 included the Amazon & Deadwood, Bismark, and Golden Point mines in the Amazon district; the State mine in the Bigfoot district; the Ida and 0-25 mines in the Boulder district; the Babe Burns, Columbia, Crystal Hill, and Golden Valley mines in the Homestake (Pipestone) district; the Shaw mine on McClellan Creek; and the Haystack Butte, John & Jim, and Triangle mines in Mitchell Gulch.

JUDITH BASIN COUNTY

Lessees continued operations in 1938 at the property of Glendennin Mines, Inc., in the Barker district; the output comprised 780 tons of silver-lead ore shipped for smelting.

LEWIS AND CLARK COUNTY

The value of the metal output from Lewis and Clark County in 1938 decreased 33 percent from 1937, owing chiefly to suspension of operations at the slag-fuming plant of the Anaconda Copper Mining Co. at East Helena. The plant, which treats current slag from the lead smelter of the American Smelting & Refining Co., was closed from July 5 to November 3, and the output of zinc-lead fume decreased markedly.

The Golden Messenger Corporation operated the 125-ton cyanidation mill at York (Dry Gulch district) at capacity in 1938, treating about 45,000 tons of ore compared with 35,033 tons in 1937; the output of gold increased 2,908 ounces and accounted for the marked increase in value of the district output. Lessees at the Federal Gold property shipped gold ore for smelting.

The Spring Hill mine near Helena was operated in 1938 by the Montana Consolidated Mines Corporation from January 1 to June 29, when operations were suspended owing to closing of the smelter at East Helena; the 300-ton flotation plant treated 52,414 tons of ore from the Spring Hill mine in 1938 compared with 89,652 tons in 1937, and the output of gold decreased proportionately. At the end of the year a 25-ton cyanidation plant to treat flotation concentrates from the Spring Hill mill was under construction; the new plant was placed in operation early in 1939. The remainder of the output from lode mines in the Helena district was crude ore shipped for smelting from several properties, including the Court House, Eula (Homestake), Jupiter, Lockey, Lone Star, Morelight, San Juan, Sky, Twylight, and Whitlatch mines. Porter Bros. Corporation operated the Yuba dredge (equipped with eighty-five 6-cubic foot buckets) north of Helena the entire year, treating 1,809,812 cubic yards of gravel (about the same amount as in 1937), but the output of gold decreased 12 percent.

Placer production from the Lincoln district decreased in 1938, as the output from the Stonewall placer was much less than in 1937. The Blue Cloud Mining Co. was organized in July to operate a dragline and washer at the Blue Cloud placer; 1,058 cubic yards of gravel were treated during 1938. Other producing placers included the Bloom & Old Billy Williams and Harvey properties; test lots of gold ore were shipped for smelting from the Gold Dollar and Sun Rise lode mines.

The value of the metal output of the Marysville (Ottawa) district increased from $110,205 in 1937 to $211,213 in 1938, owing chiefly to operations at the Empire property by the Rex Mining Co.; gold ore from the mine was treated in a small flotation plant, and lead concentrates, unusually rich in gold, were shipped for smelting. The J. C. Archibald Co. was formed during the year, and from August 1 to October 23 the company treated 10,720 tons of old tailings from the Bald Butte property by cyanidation. Lessees shipped 2,430 tons of gold ore for smelting from the Drumlummon property, and the Bald Butte Lease shipped 961 tons of gold ore from the Bald Butte mine. The remainder of the district lode ouput comprised gold ore shipped for smelting from the Big Ox, Excelsior, Meagher, North Star, Penobscot, Piegan-Gloster, Raymond & Zigmund, and Shannon mines; a little gold ore from the Climax mine, treated by amalgamation; and old tailings from two properties, treated by cyanidation. Most of the district placer output came from a dragline and washer on Silver Creek operated by J. W. Merz; the plant operated from July 11 to September 12 and treated about 40,000 cubic yards of gravel.

The Perry-Schroeder Mining Co. in 1938 completed erection of a new Yuba dredge on Eldorado Bar in the Missouri River (Hauser Lake) district; the dredge, which is equipped with jigs and has a digging ladder equipped with ninety 6-cubic foot buckets, was placed in operation November 27 and treated 75,604 cubic yards of gravel by the end of the year. In addition to gold and silver the dredge also recovers industrial sapphires. Despite operation of the new dredge the value of the placer output from the district decreased owing to closing of the Gruell Bar plant by the Lorraine Placer Mining Co.; other producing placers in 1938 included the Golden Ring & Sunset, Mable, and Ox Bow properties.

The value of the metal output of the Rimini district in 1938 decreased $46,536. Declining prices of lead and zinc caused the closing of the Montana Lead and Little Lily properties at Rimini in August; the output from the Montana Lead property was 303 tons of ore compared with nearly 2,100 tons in 1937; no production was reported at the Little Lily mine, operated by the Callahan Zinc-Lead Co. Other producers at Rimini included the Anna May & Broadway, Aurora, Kelley, and Peerless Jennie mines.

In 1938 the Franklin mine again was the chief producer in the Scratch Gravel district; lessees shipped 323 tons of gold ore from the property, a decrease from 520 tons in 1937. Other producers in the district included the Enakops, Gold Crown, Nettie, and Umatilla mines.

The value of the metal output from the Stemple (Wilborn) district in 1938 decreased 18 percent owing to lessened output from the Gould mine; the mine and 80-ton cyanidation mill were operated the full year by the Standard Silver-Lead Mining Co., and nearly 30,000 tons of gold ore and old tailings were milled, but the output of gold declined nearly 700 ounces and silver nearly 20,000 ounces. Other producers in the district included the American Boy (North Gould Mining Co.), Hubbard, Irma, and Silver Bell mines.

LIBERTY COUNTY

About 1,000 cubic yards of gravel from the Sweetgrass Placers in the Corral Creek district were treated in a washing plant during 1938; a little placer gold was recovered at the Hatch property also.

LINCOLN COUNTY

The Gold Hill property in the Cabinet district was operated a short time early in 1938 by the Viking Mining Co., and 1,500 tons of gold ore were treated in a small amalgamation and gravity-concentration plant.

The New Deal (Tip Top) mine in the Libby district was operated in 1938 by lessees; several hundred tons of ore was treated by amalgamation and concentration. A car of lead ore was shipped for smelting from the Snowshoe mine 18 miles southeast of Libby. Most of the district placer output came from the power-shovel and sluicing plant of the Liberty Placer Mining Co.; other producing placers included the Nuggett (Stone Mining Co.), Hard Times, and Libby properties.

Several thousand tons of gold ore from the Sylvanite (Keystone) property were treated by amalgamation and flotation in 1938, but the output of gold decreased more than 300 ounces. A little gold ore from the Black Diamond property (Troy Development Association) was treated by amalgamation and concentration, and lead ore from the Lead Cliff mine (mined in 1937) was shipped in 1938 for smelting.

Zinc-lead ore from the Liberty Metals and Blue Creek properties in the Troy district was sent in 1938 to the Hercules custom plant at Wallace, Idaho, for milling.

MADISON COUNTY

The value of the metal output from lode mines and placers in Madison County in 1938 increased 57 percent. There were increases in the Norris, Pony, Renova, Sheridan, Silver Star, Tidal Wave, and Washington districts; the output from Rochester and Virginia City decreased.

Mines in the Norris district (Upper and Lower Hot Springs and Norwegian) yielded metals valued at $345,291 in 1938, an increase of $99,817 over 1937. Most of the increase was from the Revenue mine in the Upper Hot Springs section, operated by the Revenue Mine Developing Group, Inc. A new 75-ton cyanidation plant at the mine was placed in operation in October and treated 6,400 tons of ore during the remainder of the year; in addition, the company shipped several hundred tons of gold ore for smelting. The Boaz mine, operated by the Boaz Lease, was again the largest producer in the district, it shipped nearly 1,800 tons of rich gold ore for smelting, a slight decrease from 1937. There was a marked increase in gold ore shipped from the Lexington mine, but that from the Josephine mine decreased. Gold ore also was shipped for smelting from the Artic, Betty May, Billy & Helen, Comstock, Eldorado, Elephant's Tail, Emperor, Galena, Grubstake, Golden Treasure, Minnie, Monitor, Montida, Pauline, Pulverizer, Rose Bud, Roy B, and Valdez mines. The floating dredge on Norwegian Creek was operated by Homer Wilson from June 25 to December 31; the output of gold increased more than 400 ounces.

Increases were reported in output in 1938 at both the Mammoth and Atlantic-Pacific properties. The Liberty Montana Mines Co. operated the Mammoth mine the full year and treated 30,862 tons of gold ore in the flotation plant; 1,932 tons of gold-copper concentrates were shipped, and the output of gold increased more than 1,400 ounces. Montana Southern Mining Co. treated 31,820 tons of gold ore from the Atlantic-Pacific mine by flotation and shipped 1,462 tons of gold concentrates for smelting; the mill was idle from July 1 to July 19, but the output of gold from the property increased more than 700 ounces. Lessees operated for 10 months at the Keystone-Strawberry group and treated 750 tons of gold ore by amalgamation and concentration. The remainder of the output from the Pony district comprised gold ore from the Bozeman mine, treated by amalgamation; gold ore shipped for smelting from the Arizona, Ben Harrison Fraction, Chile, Galena, Little King, Lone Wolf, Whip-poor-will, and White Pine mines; and clean-up material from the Boss Tweed & Clipper, Getchell, and Stone mills.

The value of the metal output from the Renova district in 1938 increased $434,570 owing to marked increase in shipments of gold ore by the West Mayflower Mining Co. (Anaconda Copper Mining Co.); the company produced 19,229 tons of rich gold ore, compared with 13,134 tons in 1937, and the mine became the largest producer of gold in Montana. Other producers in the district were the Blue Bird, Colorado, Florence, and Mary Ingabar mines.

The output from the Rochester (Rabbit) district in 1938 was less than half of that in 1937, as shipments of lead ore from the Commonwealth mine were only 124 tons compared with nearly 800 tons in 1937. Other producers included the Half Sole, Delilia, Hidden Treasure, Jack Rabbit, Long Shift, Pasadena, and Shoemaker mines.

The value of the metal output from the Sheridan district in 1938 was more than three times that in 1937 owing to increased shipments of gold ore from the Uncle Sam (Homestake) mine operated by the Sheridan Gold Mining & Milling Co. and the Fairview group operated by Fairview Gold Mines, Inc. Crude ore was shipped also for smelting from the Buckeye, Cousin Jack, Cousin Jennie, Ella Jay, Goldsmith, Jay Bird, Red Bird, Red Pine, Sarge Hall, and Sunbeam mines; in addition, gold ore from the Goldsmith, Red Pine, and Columbia mines was treated in small amalgamation mills.

Victoria Mines, Inc., operated the 100-ton cyanidation plant at the Broadway property throughout 1938 and treated 32,592 tons of ore and old tailings, a marked increase over the 1937 output; in addition, the company shipped 193 tons of gold ore for smelting. There was also a marked increase in gold ore shipped for smelting from the Golden Rod property; the mine was operated the full year by the Golden Rod Mining Co., and more than 1,000 tons of rich gold ore were shipped. The Green Campbell Mining Co. treated several hundred tons of ore in a small cyanidation plant and shipped a car of gold ore for smelting. The remainder of the output from the Silver Star district comprised gold ore shipped for smelting from the Edgerton, Governor Hayes, Jumbo, Moonlight, and Ohio mines.

The value of the metal output from the Tidal Wave district in 1938 increased $32,491 owing to increased shipments of gold ore from the High Ridge mine; the property was operated by a lessee, and 262 tons of rich gold ore were shipped for smelting. Lessees treated 400 tons of ore from the Agitator mine in a small amalgamation and concentration mill, and crude ore was shipped for smelting from the B & H, Carolina, Eagle, Eleanor & Little Goldie, Ella, Granger, Isabella, Keynote, Mountain View, Pollinger, and Smith mines.

The value of the metal output from the Virginia City district in 1938 decreased $173,819. Gold from placer mines decreased from 2,653 ounces in 1937 to 49 ounces in 1938 owing to the closing in June 1937 of the large dragline and washing plant of the Humphreys Gold Corporation. Gold from lode mines also decreased, as the output from the Marietta mine was less than one-sixth of that in 1937, when more than 12,000 tons of ore were milled. Gold ore from the

Winnetka mine was treated by amalgamation and concentration. Most of the remainder of the district output was crude ore shipped for smelting from the Alameda, Bamboo Chief, Bartlett, East & West Mapleton, Easton-Pacific, Hansen, High Up, Homestake, Prospect, St. John & Gypsy, Silver Bell, and Winnetka mines.

The Gold Creek Mining Co. completed in 1938 the erection of a floating dredge at the Washington Bar property on Meadow Creek. The new dredge has a digging ladder of seventy-six 4½-cubic foot buckets and handled 284,597 cubic yards of gravel between August 1 and December. Output from lode mines in the Washington district comprised gold ore from the Missouri-McKee mine, treated by amalgamation and concentration, and crude ore shipped for smelting from the Highland Lady, Lehigh, Missouri-McKee, and Twin Lakes mines.

MEAGHER COUNTY

A ¾-cubic yard dragline and sluicing plant on Thomas Creek was operated in 1938 by the T. C. Mine from June 19 to September 2 and treated 20,870 cubic yards of gravel. A dragline and washer was operated also in Benton Gulch at Watson by W. R. Deem. Other producing placers in the Beaver Creek district included the Bonanza, Eldorado, Sawmill, and Watson properties. A little gold ore was shipped for smelting from the Beverly Hills property in the Little Belt district.

MINERAL COUNTY

Placer gold output from the Cedar Creek district in 1938 decreased 336 ounces. Fred Byram Placers, Inc., was again the chief producer; the company operated a dragline and washer at the Calumet placer from July 15 to November 14 and treated 9,500 cubic yards of gravel. Other producing placers included the C. B. & Q., Cedar Creek, Dakota, Dr. Eddy & Nugget, McFarland, Meadow Creek, No Name & Blacktail, Ohio Gulch, Oregon Creek, Stemwinder, Stockholm, Sunlight, Swastika, and Windfall properties. A car of gold ore was shipped for smelting from the Last Chance mine near Superior.

MISSOULA COUNTY

The value of the metal output from the Coloma district in 1938 decreased slightly. The output was gold ore; it included 400 tons from the Mountain View mine, treated by amalgamation and flotation, and crude ore shipped for smelting from the Arm & Hammer, Clemantha, Dandy, Dixie, I. X. L., Mammoth, and Northern Star mines.

The output from placer mines in the Elk Creek district in 1938 increased markedly owing to operation of a dragline and washer by Norman Rogers Mining Co. on Elk Creek 7 miles southeast of Greenough.

The output from the Nine Mile district was placer gold and silver, chiefly from the Boyd, Hard Chance, Oro, and Slide placers.

The value of the metal output of the Wallace district in 1938 decreased $19,635. Copper ore from the Hidden Treasure mine decreased from nearly 1,600 tons in 1937 to 415 tons in 1938.

PARK COUNTY

The value of the metal output from Park County in 1938 decreased $213,276 owing to idleness at the New Year's Gift mine in the New World district and to the smaller output from the Jardine mine in the

Sheepeater district. The Jardine Mining Co. treated about 50,000 tons of ore in the 40-stamp amalgamation and flotation mill, but the output of gold was about 2,400 ounces less than in 1937. Other producing lode mines in the county included the Columbus and Snowshoe mines in the Crevasse district and the Homestake and Republic mines in the New World district. Most of the county placer output came from small-scale operations at the Emigrant and Hefferlin properties in Emigrant Gulch.

PHILLIPS COUNTY

The two cyanidation mills in Phillips County were operated continuously in 1938; a larger tonnage of ore was treated than in 1937, but the output of gold decreased at each plant. The Ruby Gulch Mining Co. treated 109,925 tons of ore in the 300-ton plant at Zortman and also shipped 602 tons of rich gold ore for smelting, but the output of gold from the property declined 1,320 ounces; development totaled 5,942 feet, and dividends of $55,000 were paid during the year. The Little Ben Mining Co. treated 53,581 tons of gold ore from the August mine in the 100-ton plant compared with 45,209 tons in 1937, but gold in cyanide bullion decreased about 2,400 ounces; development totaled 4,817 feet.

POWELL COUNTY

The output from placer mines in the Pioneer (Gold Creek) district in 1938 increased slightly. The Pioneer Placer Dredging Co. operated the floating dredge, equipped with seventy-eight 9-cubic foot buckets, on Gold Creek the entire year and treated 1,866,840 cubic yards of gravel from which 6,612 ounces of gold and 761 ounces of silver were recovered, an increase of 308 ounces of gold over 1937. Other producing placers in the district included the Cold Spring, Findasha & Falls, Murray Patent, Nellie B, North Fork, and Yam Hill properties.

The value of the metal output from the Zozell (Emery) district in 1938 decreased $54,493 owing to closing of the Bonanza mine. Lessees shipped 1,366 tons of gold ore from the mine compared with 5,309 tons in 1937, and the output of gold declined 1,330 ounces. Other producing mines in the district included the Argus, Blue Eyed Maggie, Emery, Emma Darling, Hidden Hand, and Sabbath Day properties, all producers of crude ore shipped for smelting.

The Hattie M. & Annie R. property near Elliston (Nigger Hill district) was operated by Newman Bros.; gold ore was treated in a small amalgamation and concentration mill, and 159 tons of gold ore were shipped for smelting. Gold ore from the Big Dick mine also was treated by amalgamation and concentration, and ore was shipped for smelting from the Hi-Ore & Hi-Way, Lilly, Hub Camp, and Ontario mines. Considerable placer gold was produced by the Duclo Mining Co. at a dragline plant in Reinig Gulch.

The placer output from the Washington Gulch district in 1938 decreased markedly owing to the closing in October 1937 of the dragline plant at the Fontana property. The C. A. Wagner Construction Co. installed a dragline and washing plant in Buffalo Gulch and treated 35,967 cubic yards of gravel between September 1 and November 9. Other producing placers in the district included the Beatrice, Cornucopia, Gold Bar, Old Shoe, Rietz, and Whitetail properties. Small lots of rich gold ore were shipped from the Grey (Great States Gold Mining Co.) and Mascotte lode mines.

Other producing mines in Powell County in 1938 included the Hill Top and Sweepstake & Sunrise lode mines near Helmville (Big Blackfoot district), the Dark Horse lode mine in the Race Track Creek district, and Harps Placer in Ophir Gulch.

RAVALLI COUNTY

The Hamilton Victor Reduction Co. operated the 100-ton flotation plant at the Curlew property for 7 months in 1938. Nearly 18,000 tons of old tailings were treated in the mill, and lead concentrates and zinc concentrates were shipped; in addition, the company shipped about 600 tons of gold ore for smelting. Gold ore from the Washington mine in the Overwich district was treated by amalgamation. A test lot of gold ore from the White Cloud mine in the Eight Mile Creek district was shipped for smelting. Most of the placer output from Ravalli County came from the Hogue property in the Overwich district.

SANDERS COUNTY

The American Smelting & Refining Co. operated the Jack Waite mine in the Eagle district throughout 1938. This property extends over the State line into Shoshone County, Idaho, and production was reported from both States. The output from the Montana section comprised 43,390 tons of ore treated in the flotation plant at Duthie, Idaho, and 1,278 tons of rich lead ore shipped for smelting. Output of all five metals decreased slightly, and lower average sales prices resulted in a marked decrease in total value of the district metal output. The Green Mountain Mining Co. operated the Drake (Dixon) property in the Revais Creek district in 1938 from August until the end of the year; shipments of copper ore totaled 42 tons, a decrease from more than 600 tons in 1937. A little copper ore was shipped from the New Deal mine also. The placer output from the Vermillion district came from the Mammy Lou & Driftwood and Ogoma properties.

SILVER BOW COUNTY

The following table gives the output of mines in Silver Bow County, which includes the Butte or Summit Valley district, in 1937 and 1938 and the total from 1882 (the first year for which detailed records are available) to the end of 1938.

Production of gold, silver, copper, lead, and zinc in Silver Bow County, Mont., 1937–38, and total, 1882–1938, in terms of recovered metals [1]

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*	
1937	84	3, 684, 972	20, 521	8, 071, 519	287, 757, 000	11, 560, 000	44, 066, 000	$45, 326, 482
1938	55	1, 642, 491	15, 147	4, 018, 192	153, 709, 857	414, 978	1, 883, 417	18, 300, 823
1882–1938 [1]		(2)	1, 876, 183	493, 902, 691	[3] 5, 656, 539	[3] 193, 539	[3] 1,415, 905	2, 305, 362, 336

[1] Grand total, 1882–1937, inclusive, given in Minerals Yearbook, 1938, p. 356, is in error. Total in this table includes corrections. No annual figures have been changed.
[2] Figures not available.
[3] Short tons.

Butte or Summit Valley district.—The Anaconda Copper Mining Co. operated its copper mines at Butte at a reduced rate throughout 1938, continuing a curtailment that was begun in the last quarter of 1937. Copper ore sent to the copper concentrator at Anaconda decreased from 3,068,665 tons in 1937 to 1,561,186 tons in 1938; the sand-leaching plant at Anaconda was not operated in 1938 (it treated 307,014 tons of old sand tailings in 1937). Copper ore shipped direct to the smelter increased from 35,639 to 45,161 tons, but mine-water precipitates decreased from 6,298 to 4,045 tons. Net copper produced from copper ores decreased 46 percent from 1937, gold 64 percent, and silver 42 percent. Development at all copper claims totaled 112,032 feet compared with 180,181 feet in 1937. The zinc mines of the Anaconda Copper Mining Co. at Butte were closed in the summer of 1937 and were not in production during 1938; limited development (9,614 feet) was continued at the zinc properties, and the output of zinc-lead ore (entirely from development) was only 2,638 tons in 1938, a decrease from 119,536 tons in 1937, resulting in marked decreases in the output of all five metals. The Emma mine (owned by the Butte Copper & Zinc Co. but operated under lease by the Anaconda Copper Mining Co.) was closed January 20, 1938, and only 7,208 tons of zinc-lead ore were produced compared with 107,428 tons in 1937. The zinc concentrator at Anaconda also was closed most of the year, and custom shippers of zinc-lead ore, chiefly those at Philipsburg, were forced to suspend production. The Green Copper property at Butte was operated by a lessee who shipped 618 tons of copper ore to the copper concentrator at Anaconda and 48 tons of zinc-lead ore to the Comet mill near Basin for milling. All the remainder of the district output was crude ore shipped for smelting from the Alice, Amy Silversmith, Anna, Black Rock, Eveline, Fayal, Glengary, Gulch, Hawkeye, Illinois, Josephine, Jumbo, Lavena, Magna Charta, Magnolia, Minnie Jane, Pittsmont, Sailor's Dream, Saukie, and Valdemere mines.

The Butte Highlands Mining Co. operated throughout 1938 at the Highlands (Tilton) group in the Highlands district southeast of Butte. The 75-ton cyanidation mill, placed in operation in November 1937, treated 17,985 tons of ore and old tailings in 1938 (a marked increase from the 2,543 tons treated in 1937), and the output of gold increased from 862 ounces to 8,849 ounces.

The remainder of the output from lode mines in Silver Bow County in 1938 comprised ore shipped for smelting from the Goldflint and Nettie mines in the Independence district and the Blue Bird, O. K., and Way Up mines in the Melrose district.

TOOLE COUNTY

All the output from Toole County in 1938 came from placers in Eclipse Gulch; about 76,300 cubic yards of gravel were treated by Gold Butte Placers in a dragline and washing plant.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEVADA

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord [1]

SUMMARY OUTLINE

Nevada's mining industry in 1938 was characterized by a halving of the combined value of the output of the base metals—copper, lead, and zinc—compared with 1937. The value of gold production increased slightly and was greater than in any year since 1915; it was the State's most valuable mineral product in 1938. The total value of the gold, silver, copper, lead, and zinc produced in Nevada was $23,529,064 in 1938 compared with $34,617,056 in 1937, a decline of 32 percent. Gold increased 5 percent in both quantity and value. The other metals decreased, as follows: Silver, 10 percent in quantity and 25 percent in value; copper, 38 and 50 percent, respectively; lead, 50 and 61 percent, respectively; and zinc, 37 and 54 percent, respectively. Of the total value of the five metals in 1938, gold accounted for 44 percent, copper 38 percent, silver 12 percent, zinc 4 percent, and lead 2 percent.

During 1938 White Pine County continued to be the largest contributor to the nonferrous metal wealth of the State; it ranked first in output of copper, second in gold, and third in silver. Esmeralda County was the leading producer of the two precious metals and Lincoln County 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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price for all grades of primary metal sold by producers. [4] $0.64646464.

[1] The assistance of L. F. Janssen is acknowledged.

Mine production of gold, silver, copper, lead, and zinc in Nevada, 1934–38, and total, 1859–1938, 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
1934	635	160	2,899,782	144,275.17	$5,042,417	3,057,114	$1,976,316
1935	706	149	4,392,819	188,031.00	6,581,085	4,393,426	3,157,775
1936	661	119	6,584,138	286,370.00	10,022,950	5,068,786	3,925,775
1937	682	117	7,565,466	281,332.00	9,846,620	4,864,750	3,762,884
1938	795	130	5,880,021	296,434.00	10,375,190	4,355,471	2,815,658
1859–1938 [2]			(3)	23,663,592.00	506,787,396	565,384,135	523,522,126

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	41,611,119	$3,328,890	21,981,874	$813,329	27,880,790	$1,198,874	$12,359,826
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	17,880,000	858,624	23,529,064
1859–1938 [2]	[4] 1,241,532	370,288,746	[4] 495,601	52,863,277	[4] 225,645	31,055,264	1,484,516,809

[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 1938, inclusive, the output was as follows: Gold, 11,836,715.51 ounces, valued at $262,304,163; silver, 276,971,286 ounces, $186,363,903; copper, 1,239,606 short tons, $369,642,118; lead, 257,810 short tons, $30,226,715; zinc, 225,645 short tons, $31,055,264; total value, $879,592,163.

[3] Figures not available.

[4] Short tons.

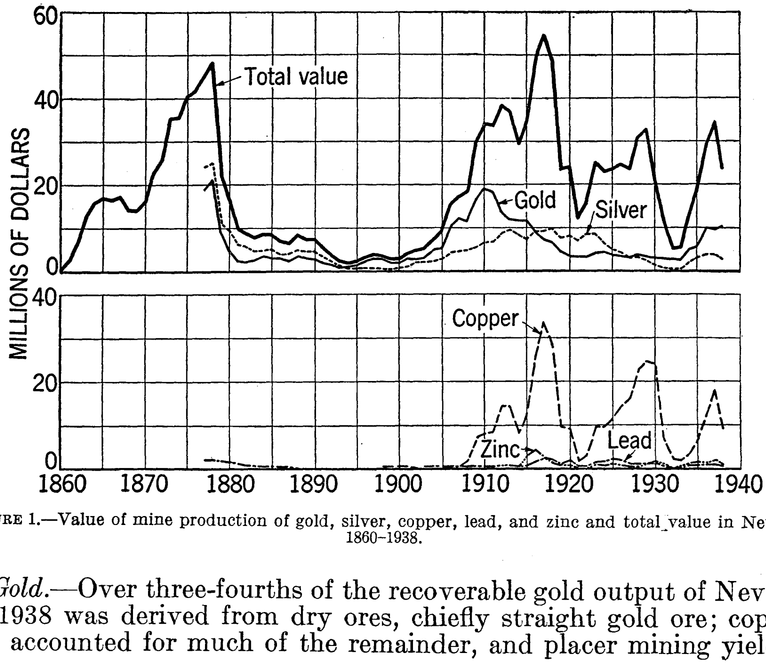

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Nevada, 1860–1938.

Gold.—Over three-fourths of the recoverable gold output of Nevada in 1938 was derived from dry ores, chiefly straight gold ore; copper ore accounted for much of the remainder, and placer mining yielded

4 percent of the total. Ten companies in Nevada produced 50 percent of the State total gold; the following table lists these producers in order of output.

Ten leading gold producers in Nevada in 1938, in order of output

Mine	District	County	Rank in 1937	Operator	Source of gold
Mary	Silver Peak	Esmeralda	4	Black Mammoth Consolidated Mining Co.	Gold ore.
Emma Nevada	Robinson	White Pine	2	Consolidated Coppermines Corporation and lessees.	Copper ore. [1]
Getchell	Potosi	Humboldt	[2]	Getchell Mine, Inc	Gold ore.
Ruth and Copper Flat Pit.	Robinson	White Pine	1	Nevada Consolidated Copper Corporation.	Copper ore.
Weepah	Lone Mountain	Esmeralda	3	Weepah Nevada Mining Co.	Gold ore.[3]
Overman	Comstock	Storey	11	Consolidated Chollar Gould & Savage Mining Co.	Gold ore.
Chiquita	Yellow Pine	Clark	9	Chiquita Mining Co., Ltd.	Do.
Mizpah	Tonopah	Nye	8	Lessees of The Tonopah Mining Co. of Nevada.	Gold-silver ore.
Penelas	Phonolite	do	13	Penelas Mining Co	Gold ore.
Sierra Nevada	Comstock	Storey	22	Sierra Nevada, Ltd	Do.

[1] Gold-silver ore and lead ore also source of small part of the gold.
[2] Production started Mar. 1, 1938.
[3] Approximately three-fourths ore and one-fourth old tailings.

Silver.—Of the 10 leading producers of silver in Nevada in 1938 (listed in the following table), only 2 derived their output from straight silver ore; at the other 8 mines silver was a byproduct of gold-silver, zinc-lead, and copper ores. These 10 mines produced 66 percent of the State total.

Ten leading silver producers in Nevada in 1938, in order of output

Mine	District	County	Rank in 1937	Operator	Source of silver
Nivloc	Silver Peak	Esmeralda	5	Desert Silver, Inc	Silver ore.
Mizpah	Tonopah	Nye	1	Lessees of The Tonopah Mining Co. of Nevada.	Gold-silver ore.
Emma Nevada	Robinson	White Pine	10	Consolidated Coppermines Corporation and lessees.	Copper ore.[1]
Pioche No. 1	Pioche	Lincoln	2	Combined Metals Reduction Co.	Zinc-lead and lead ores.
Tonopah Belmont	Tonopah	Nye	4	Tonopah Belmont Development Co., lessees, and sublessees.	Gold-silver ore.
Bristol Silver	Jack Rabbit	Lincoln	12	Bristol Silver Mines Co	Silver ore.
Overman	Comstock	Storey	13	Consolidated Chollar Gould & Savage Mining Co.	Gold ore.
Crown Point	do	do	11	Sutro Tunnel Coalition, Inc.	Gold-silver ore.
Ruth and Copper Flat Pit.	Robinson	White Pine	6	Nevada Consolidated Copper Corporation.	Copper ore.
Nevada Standard	Cherry Creek	do	9	Nevada Standard Mining Corporation.	Gold-silver ore.

[1] Gold-silver ore and lead ore also source of small part of the silver.

Copper.—Almost 98 percent of the recoverable copper production of Nevada in 1938 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 and the Consolidated Coppermines Corporation working the Emma Nevada mine (all in the Robinson district of White Pine County), and the Mountain City Copper Co. working the Mountain City mine in the Cope district of Elko County. The sharp decrease in total output from 1937, the all-time record year for the State, was the result of a production-curtailment program at the three leading copper-producing properties.

Lead.—Two-thirds of the recoverable lead output of Nevada in 1938 was derived from zinc-lead ore mined by the Combined Metals Reduction Co. at the Pioche No. 1 mine in the Pioche district of Lincoln County. The Bristol Silver Mines Co. operating in the Jack Rabbit district of Lincoln County and the Yellow Pine Development Co. in the Yellow Pine district of Clark County recovered much smaller, but substantial, quantities of lead. The outstanding cause of the great decline in the lead production of Nevada in 1938 was suspension of operations at the Tybo mine in the Tybo district of Nye County, upon exhaustion of its known ore bodies late in 1937; the lower average lead price in 1938 was also an adverse factor.

Zinc.—Following the closing of the Tybo mine late in 1937, the Pioche No. 1 mine of the Combined Metals Reduction Co. was the only large producer of zinc in Nevada; it was the source of over nine-tenths of the recoverable zinc output of the State in 1938. The only other production of any size came from the property of the Yellow Pine Development Co. in the Yellow Pine district of Clark County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer)	
			Lode		Placer		Total			
	Lode	Placer	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Churchill	34	1	1,517	$53,095	1	$35	1,518	$53,130	76,736	$49,607
Clark	54	1	20,051	701,785	13	455	20,064	702,240	127,067	82,144
Douglas	6	1	29	1,015	6	210	35	1,225	45	29
Elko	54	5	6,254	218,890	80	2,800	6,334	221,690	119,451	77,221
Esmeralda	42	11	61,064	2,137,240	147	5,145	61,211	2,142,385	848,775	548,703
Eureka	32	11	8,585	300,475	324	11,340	8,909	311,815	139,564	90,223
Humboldt	45	9	28,166	985,810	378	13,230	28,544	999,040	21,138	13,665
Lander	49	17	7,416	259,560	6,033	211,155	13,449	470,715	128,988	83,386
Lincoln	35	--------	7,663	268,205	--------	--------	7,663	268,205	638,768	412,941
Lyon	49	4	10,506	367,710	63	2,205	10,569	369,915	37,911	24,508
Mineral	86	3	6,090	213,150	41	1,435	6,131	214,585	64,543	41,725
Nye	100	37	28,607	1,001,245	3,913	136,955	32,520	1,138,200	808,689	522,789
Ormsby	1	--------	3	105	--------	--------	3	105	4	3
Pershing	60	18	3,215	112,525	777	27,195	3,992	139,720	47,881	30,953
Storey	36	2	39,182	1,371,370	99	3,465	39,281	1,374,835	583,645	377,306
Washoe	26	3	973	34,055	97	3,395	1,070	37,450	5,528	3,574
White Pine	86	7	54,154	1,895,390	987	34,545	55,141	1,929,935	706,738	456,881
	795	130	283,475	9,921,625	12,959	453,565	296,434	10,375,190	4,355,471	2,815,658
Total, 1937	682	117	271,569	9,504,915	9,763	341,705	281,332	9,846,620	4,864,750	3,762,884

[1] Excludes itinerant prospectors, snipers, high-graders, and others who gave no evidence of legal right to property.

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, by counties, in terms of recovered metals—Continued

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Churchill			6,000	$276			$103,013
Clark	28,000	$2,744	572,000	26,312	1,052,000	$50,496	863,936
Douglas							1,254
Elko	13,306,000	1,303,988	302,000	13,892	8,000	384	1,617,175
Esmeralda	4,000	392	64,000	2,944			2,694,424
Eureka	4,000	392	258,000	11,868			414,298
Humboldt	4,000	392	32,000	1,472			1,014,569
Lander	800,000	78,400	84,000	3,864			636,365
Lincoln	1,124,000	110,152	7,512,000	345,552	16,828,000	807,744	1,944,594
Lyon	10,000	980					395,403
Mineral	4,000	392	66,000	3,036			259,738
Nye	6,000	588	160,000	7,360			1,668,937
Ormsby							108
Pershing	14,000	1,372	96,000	4,416			176,461
Storey	4,000	392	4,000	184			1,752,717
Washoe	10,000	980	12,000	552			42,556
White Pine	77,020,000	7,547,960	190,000	8,740			9,943,516
	92,338,000	9,049,124	9,358,000	430,468	17,888,000	858,624	23,529,064
Total, 1937	149,206,000	18,053,926	18,694,000	1,102,946	28,472,000	1,850,680	34,617,056

MINING INDUSTRY

Curtailment of operations at the three large copper mines in Nevada was an outstanding feature of the mining industry in 1938. Production of copper ore decreased 29 percent compared with 1937. Production of ores valued chiefly for lead and zinc declined sharply but comprised a very small part of the total output of the State. There was a slight increase in quantity of dry and siliceous precious-metal material handled, and a smaller proportion of such material consisted of old tailings than in 1937. The installation of a large connected-bucket dredge, the first to operate in Nevada in several years, was a feature of the mining industry in 1938. The quantity of gravel handled at Nevada placers increased.

Getchell Mine, Inc., started production at the Getchell mine in the Potosi district of Humboldt County early in 1938 and was the third largest gold producer in the State during the year. The company was on a dividend-paying basis by the end of 1938. Among the major producers who ceased operations late in 1937 or during 1938 were: Eastern Exploration Co., Goldfield district, Esmeralda County; Arizona Comstock Corporation, Comstock district, Storey County; Buckhorn Mining Co., Buckhorn district, Eureka County; Treadwell Yukon Co., Ltd., Tybo district, Nye County; and Pioche Mines Consolidated, Pioche district, Lincoln County.

ORE CLASSIFICATION

The following table classifying ores produced in Nevada in 1938 shows that 69 percent of the tonnage of ore (including old tailings) sold or treated was copper ore, 24 percent gold ore, 4 percent gold-silver ore, 2 percent silver ore, and the remaining 1 percent zinc-lead and lead 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 1938, 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	886, 994	512, 734	197, 434	584, 636	227, 100	88, 200	
Dry and siliceous gold-silver ore	206, 586	24, 197	31, 252	1, 574, 816	17, 400	326, 900	
Dry and siliceous silver ore	105, 789	8, 760	3, 513	1, 281, 824	1, 127, 000	1, 020, 900	8, 000
	1, 199, 369	545, 691	232, 199	3, 441, 276	1, 371, 500	1, 436, 000	8, 000
Copper ore	4, 043, 892		47, 024	437, 970	90, 940, 400	1, 200	
Lead ore	28, 325		3, 108	152, 074	26, 100	1, 290, 800	
Zinc-lead ore	62, 744		1, 144	320, 943		6, 630, 000	17, 880, 000
Total, lode mines	5, 334, 330	545, 691	283, 475	4, 352, 263	92, 338, 000	9, 358, 000	17, 888, 000
Total, placers			12, 959	3, 208			
	5, 334, 330	545, 691	296, 434	4, 355, 471	92, 338, 000	9, 358, 000	17, 888, 000
Total, 1937	6, 958, 702	606, 764	281, 332	4, 864, 750	149, 206, 000	18, 694, 000	28, 472, 000

METALLURGIC INDUSTRY

Of the 5,880,021 tons of lode material sold or treated in 1938 in Nevada more than 70 percent was ore sent to concentration mills, 17.5 percent was ore sent to amalgamation and cyanidation mills, 9 percent was old tailings sent to amalgamation and cyanidation mills, 3 percent was ore shipped crude to smelters, and the remainder (less than 0.5 percent) was old tailings shipped to smelters. The principal changes from 1937 were a decrease in proportion of total ore sent to concentration mills and a marked increase in proportion of ore treated at amalgamation and cyanidation mills. In 1938 flotation was employed at concentration mills to the virtual exclusion of gravity concentration; in former years gravity concentration had been used on a larger part of the ore treated. At amalgamation and cyanidation mills much more of the material was treated by cyanidation than by amalgamation; nearly all the old tailings sent to such mills were cyanided. Of the total gold recovered as bullion, cyanidation accounted for 77 percent and amalgamation 23 percent. The quantity of crude ore shipped to smelters declined 37 percent from 1937. There was a very large drop in White Pine County, where decreased output of copper concentrates lessened the need for siliceous ores for fluxing purposes at the McGill smelter. Curtailed operations at the Mountain City copper property in the Cope district of Elko County and exhaustion of its very high grade smelting ore combined to decrease the output of copper ore from that property. The roaster and cyanide plant [2] at the Getchell mine was the outstanding addition to the metallurgical equipment of the State to start operating during 1938.

Custom mills were operated in various parts of the State during 1938; those of importance were at Silver City in Lyon County and at Searchlight, Goodsprings, and Nelson in Clark County. Most of the custom mills derived part of their mill feed from mines worked by the mill operators. Large quantities of ore and concentrates were

[2] Engineering and Mining Journal, vol. 139, No. 8, August 1938, p. 84.

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, operated by the Nevada Consolidated Copper Corporation, continued in 1938 to be the only smelter and the most important metallurgical plant in the State.

Mine production of metals in Nevada in 1938, 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	458,485	35,151	28,901			
Ore, old tailings, sands, slimes, and concentrates cyanided	1,171,140	116,765	1,351,128	[1] 1,300		
Concentrates smelted:						
Flotation	212,957	71,159	1,122,935	86,877,900	6,320,300	16,836,000
Gravity	343	3,123	5,820	2,600	26,400	
Ore and old tailings smelted	179,266	57,277	1,843,479	5,456,200	3,011,300	1,052,000
Total, lode mines		283,475	4,352,263	92,338,000	9,358,000	17,888,000
Total, placers		12,959	3,208			
		296,434	4,355,471	92,338,000	9,358,000	17,888,000
Total, 1937		281,332	4,864,750	149,206,000	18,694,000	28,472,000

[1] From "cyanide" precipitates.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1938, 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	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*
Churchill	434		31	142	5	3	58		
Clark	35,671		6,107	2,225	290	2,108	12,489	2,900	700
Douglas	120		13	6					
Elko	1,689		361	379	8	65	401		
Esmeralda	71,611		5,461	1,417	1,039	6,478	2,714	400	31,400
Humboldt	11,451	140	3,527	3,770					
Lander	921		277	153	2	8	242		300
Lincoln	1		1	1					
Lyon	22,727	100	3,017	2,250	135	1,016	3,662	300	
Mineral	1,773		663	388	33	110	385		
Nye	21,602	1,750	6,648	3,042	469	1,612	1,001		
Pershing	4,507	4	1,403	9,471	11	57	203		
Storey	282,121	100	6,955	5,348	1,568	12,234	223,566	3,100	3,200
Washoe	1,460		604	274					
White Pine	303		83	35	9	27	5		
	456,391	2,094	35,151	28,901	3,569	23,718	244,726	6,700	35,600
Total, 1937	478,773	7,238	27,420	19,852	2,825	18,850	329,951	14,300	21,300

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Nevada in 1938, 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*
Churchill	3,070	1,700	573	13,394					
Clark	34,320		6,894	46,510					
Douglas	31		13	6					
Elko	25,942	1,619	2,380	54,911					
Esmeralda	199,139	[2] 370,468	41,184	807,921	9	3	1,913		4,800
Eureka	20,000		1,632	710	6	1,899	1,063		
Humboldt	159,852		23,586	2,028					
Lander	8,300	63	1,578	608					
Lincoln		125,358	3,887	17,528					
Lyon	24,198	17,600	6,400	31,452					
Mineral	3,089	440	2,730	4,284	2	4	8		
Nye	19,744	300	6,292	17,805					
Pershing	130	450	63	225					
Storey	140,348	12,579	19,552	345,920	96	160	4,191		
White Pine		2,400	1	7,826					
	638,163	[2] 532,977	116,765	1,351,128	113	2,066	7,175		4,800
Total, 1937	433,677	571,915	79,883	774,249	142	644	67	3,500	1,200
Grand total:									
1938	1,094,554	[2] 535,071	151,916	1,380,029	3,682	25,784	251,901	6,700	40,400
1937	912,450	579,153	107,303	794,101	2,967	19,494	330,018	17,800	22,500

[1] Ore figures include sands, slimes, and concentrates cyanided.
[2] 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 1938, 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	4,767	915	12,355	1,101	143,400	337,873
Dry gold-silver	50	162	3,534			
Dry silver	27	9	10,068	286	598	
Copper	182,469	44,266	418,257	90,573,324		
Lead	5,929	2,989	389,340	13,532	6,121,413	987,982
Zinc	16,376	157	43,300		340,413	18,707,589
Total	209,618	48,498	876,854	90,588,243	6,605,824	20,033,444
1937	311,778	81,249	1,471,728	139,175,851	15,094,984	30,977,222

Mine production of metals from concentrating mills in Nevada in 1938, in terms of recovered metals

BY COUNTIES

	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*
Clark	23,318		146	2,157	50,836	5,200	20,400	
Elko	60,914		20,338	229	8,612	9,861,700	10,000	8,000
Humboldt	939		44	157	3,321			
Lander	2,588		124	11	42,850	3,300	11,500	
Lincoln	76,072		26,672	1,393	354,944	2,700	6,245,000	16,828,000
Lyon	50		2	3	108			
Storey	1,000		73	281	4,489	900	800	
Washoe	25		12		111		2,900	
White Pine	3,969,474		162,207	44,267	411,583	77,000,000	15,700	
Total	4,134,380		209,618	48,498	876,854	86,873,800	6,306,300	16,836,000
1937	5,905,908	210	311,778	81,249	1,471,728	132,906,135	14,380,000	27,797,300

BY CLASSES OF CONCENTRATES

	Concentrates produced	Gold	Silver	Copper	Lead	Zinc
Dry gold	4,767	915	12,355	900	107,629	
Dry gold-silver	50	162	3,534			
Dry silver	27	9	10,068	200	400	
Copper	182,469	44,266	418,257	86,861,500		
Lead	5,929	2,989	389,340	11,200	5,874,893	
Zinc	16,376	157	43,300		323,378	16,836,000
	209,618	48,498	876,854	86,873,800	6,306,300	16,836,000

Gross metal content of concentrates produced from ores mined in Nevada in 1938, 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	7,420	17,739	91,698	7,926	180,471	337,873
Dry gold-silver	1,068	9,111	173,937	3,182		
Dry silver	36	12	11,981	286	5,648	
Copper	182,469	44,266	418,257	90,573,324		
Lead	5,931	2,997	389,582	13,532	6,121,802	987,982
Zinc	16,376	157	43,300		340,413	18,707,589
	213,300	74,282	1,128,755	90,598,250	6,648,334	20,033,444
Total, 1937	317,596	101,704	1,833,264	139,200,884	15,119,597	30,977,222

Mine production of metals from Nevada concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	5	3	58			
Clark	436	4,265	63,325	8,100	21,100	
Elko	20,346	294	9,013	9,861,700	10,000	8,000
Esmeralda	1,048	6,481	4,627	400	36,200	
Eureka	6	1,899	1,063			
Humboldt	44	157	3,321			
Lander	126	19	43,092	3,300	11,800	
Lincoln	26,672	1,393	354,944	2,700	6,245,000	16,828,000
Lyon	137	1,019	3,770	300		
Mineral	35	114	393			
Nye	469	1,612	1,001			
Pershing	11	57	203			
Storey	1,737	12,675	232,246	4,000	4,000	
Washoe	12		111		2,900	
White Pine	162,216	44,294	411,588	77,000,000	15,700	
	213,300	74,282	1,128,755	86,880,500	6,346,700	16,836,000
Total, 1937	314,745	100,743	1,801,746	132,923,935	14,402,500	27,797,300

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	7,420	17,739	91,698	5,700	142,929	
Dry gold-silver	1,068	9,111	173,937	1,900		
Dry silver	36	12	11,981	200	5,200	
Copper	182,469	44,266	418,257	86,861,500		
Lead	5,931	2,997	389,582	11,200	5,875,193	
Zinc	16,376	157	43,300		323,378	16,836,000
	213,300	74,282	1,128,755	86,880,500	6,346,700	16,836,000

Gross metal content of Nevada crude ore shipped to smelters in 1938, 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	59,368	35,213	120,350	243,324	66,544	861
Dry and siliceous gold-silver	55,183	[1] 17,151	[1] 1,119,203	16,342	246,577	
Dry and siliceous silver	32,442	525	407,070	1,225,996	1,054,306	
Copper	14,590	2,758	19,713	4,205,745	2,061	
Lead	4,852	950	101,089	26,040	1,352,448	4,682
Zinc-lead	2,211				641,881	1,302,261
	168,646	[1] 56,597	[1] 1,767,425	5,717,447	3,363,817	1,307,804
Total, 1937	266,215	63,523	2,266,372	16,833,374	4,830,800	934,263

[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 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Churchill	2,210	910	63,141		6,000	
Clark	4,372	2,785	15,004	19,900	550,900	1,052,000
Douglas	3	3	31			
Elko	13,056	2,903	34,569	3,444,200	292,000	
Esmeralda	6,596	7,938	34,782	2,300	27,800	
Eureka	24,718	5,051	137,695	4,000	258,000	
Humboldt	1,488	896	11,976	4,000	32,000	
Lander	12,528	5,542	84,405	796,700	72,200	
Lincoln	28,307	2,237	252,105	1,119,300	1,188,500	
Lyon	186	70	408	9,700		
Mineral	3,595	2,583	59,450	4,000	66,000	
Nye	26,148	14,042	779,875	6,000	160,000	
Pershing	2,350	1,692	37,833	14,000	96,000	
Washoe	1,028	369	5,072	10,000	9,100	
White Pine	42,061	[1] 9,576	[1] 251,079	20,000	174,300	
	168,646	[1] 56,597	[1] 1,767,425	5,454,100	2,932,800	1,052,000
Total, 1937	266,215	63,523	2,266,372	16,282,065	4,291,500	674,700

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	59,368	35,213	120,350	218,500	53,300	
Dry and siliceous gold-silver	55,183	[1] 17,151	[1] 1,119,203	14,300	213,500	
Dry and siliceous silver	32,442	525	407,070	1,121,500	963,300	
Copper	14,590	2,758	19,713	4,078,900	1,200	
Lead	4,852	950	101,089	20,900	1,252,000	
Zinc-lead	2,211				449,500	1,052,000
	168,646	[1] 56,597	[1] 1,767,425	5,454,100	2,932,800	1,052,000

[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 1938, 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		2	1		1	24		100		$55
Broken Hills	2		78	16		16	2,089		3,600		2,076
Desert	2		345	30		30	314				1,253
Dixie Valley	2		1,732	278		278	324				9,939
Eastgate	1		66	73		73	385				2,804
Fairview	10		3,344	303		303	20,238				23,688
Holy Cross	3		14	14		14	4,936		2,300		3,787
Jessup	1	1	28	21	1	22	36				793
Sand Springs	3		222	163		163	6,192				9,708
Wonder	9		1,583	618		618	42,198				48,910
Clark County:											
Crescent	7		253	29		29	11,322	500	4,600		8,595
Eldorado Canyon	5		44,495	5,588		5,588	107,261	5,300	20,600		266,387
Gold Butte	2		48	33		33	16	100			1,175
Searchlight	28	1	4,646	4,053	13	4,066	6,871	3,000	9,400		147,478
Yellow Pine	12		26,450	10,348		10,348	1,597	19,100	537,400	1,052,000	440,301
Douglas County:											
Gardnerville	1		2	2		2	24				86
Mt. Siegel		1			6	6	2				211
Mountain House	2		131	22		22	11				777
Silver Glance	3		21	5		5	8				180
Elko County:											
Castle Park	1		23				31	4,000			412
Centennial	2		809	282		282	317	200	4,000		10,279
Contact	3		15	27		27	88	2,800	200		1,285
Cope	6	2	66,600	29	74	103	10,198	13,125,500	500		1,296,521
Cornucopia	1		2,250	316		316	20,547	100			24,353
Delano	2		162				5,012	100	70,000		6,470
Dolly Varden	1		3				27		600		45
Gold Circle	6		25,856	2,442		2,442	54,717		800		120,879
Island Mountain	3	1	181	62	3	65	236		1,900		2,515
Jarbidge	8		1,391	400		400	950				14,614
Lime Mountain	1		5,308	2,458		2,458	7,368	162,000			106,669
Mardis	2		67	194		194	156	900			6,979
Merrimac	2		259	2		2	7,716	800	47,900	8,000	7,724
Pilot Mountain	1		3				127				82
Rock Creek	1		7				336				217
Spruce Mountain	6		476	10		10	8,140	5,200	157,100		13,348
Tecoma	1		23				221		19,000		1,017
Tuscarora	7	2	1,395	32	3	35	3,264	4,400			3,766

Esmeralda County:											
Desert	7	1	352	252	8	260	426	-----	-----	-----	9,375
Divide	6	-----	1,285	738	-----	738	23,815	-----	-----	-----	41,226
Dyer	1	-----	48	1	-----	1	4,731	400	5,100	-----	3,367
Goldfield	10	-----	348,519	9,292	-----	9,292	5,339	3,100	5,400	-----	329,224
Hornsilver	4	-----	6,258	1,689	-----	1,689	8,436	100	6,500	-----	64,877
Klondyke	3	-----	53	24	-----	24	1,356	-----	6,900	-----	2,034
Lida	1	5	1	-----	113	113	24	-----	-----	-----	3,971
Lone Mountain	1	-----	108,339	11,253	-----	11,253	24,211	-----	-----	-----	409,507
Montezuma	1	-----	14	-----	-----	-----	388	-----	2,400	-----	361
Palmetto	2	1	85	48	2	50	7	-----	-----	-----	1,755
Silver Peak	6	-----	182,860	37,767	-----	37,767	780,037	400	37,700	-----	1,827,884
Sylvania	-----	4	-----	-----	24	24	5	-----	-----	-----	843
Eureka County:											
Buckhorn	1	-----	2,792	551	-----	551	4,489	-----	-----	-----	22,187
Cortez	4	-----	20,430	3,563	-----	3,563	32,085	1,000	27,000	-----	146,786
Diamond	2	-----	529	5	-----	5	8,004	-----	8,200	-----	5,727
Eureka	17	-----	20,829	4,437	-----	4,437	84,732	1,000	208,500	-----	219,759
Fish Creek	1	-----	35	-----	-----	-----	238	-----	7,300	-----	490
Lynn	3	11	75	29	324	353	41	-----	-----	-----	12,382
Mineral Hill	3	-----	68	-----	-----	-----	903	-----	-----	-----	584
Safford	1	-----	46	-----	-----	-----	9,072	2,000	7,000	-----	6,383
Humboldt County:											
Awakening	8	-----	9,808	2,545	-----	2,545	1,603	-----	-----	-----	90,111
Barrett Springs	5	-----	425	362	-----	362	4,171	200	6,900	-----	15,703
Central	9	-----	159	52	-----	52	2,640	700	16,000	-----	4,331
Donnelly	2	-----	98	32	-----	32	33	-----	-----	-----	1,141
Dutch Flat	-----	(4)	-----	-----	6	6	-----	-----	-----	-----	210
Florence	4	-----	68	44	-----	44	306	700	-----	-----	1,806
Gold Run	5	4	835	261	56	317	4,071	-----	8,100	-----	14,099
Jackson Creek	1	-----	1	3	-----	3	1	-----	-----	-----	106
National	1	1	941	420	11	431	3,639	-----	-----	-----	17,437
Potosi	2	-----	159,857	23,574	-----	23,574	2,964	-----	-----	-----	827,006
Rebel Creek	1	-----	10	6	-----	6	8	-----	-----	-----	215
Rosebud	-----	(4)	-----	-----	246	246	29	-----	-----	-----	8,629
Sawtooth	(5)	1	(5)	(5)	13	[6] 13	[6] 1	-----	-----	-----	[6] 456
Varyville	2	1	256	219	2	221	913	2,400	-----	-----	8,560
Warm Springs	2	-----	1,360	646	-----	646	59	-----	-----	-----	22,648
Lander County:											
Battle Mountain	24	7	10,666	4,396	1,833	6,229	27,083	770,300	18,700	-----	311,872
Bullion	9	10	9,501	2,103	4,200	6,303	25,787	8,700	46,600	-----	240,271
Hilltop	4	-----	435	360	-----	360	9,680	3,200	3,200	-----	19,319
Kingston	1	-----	288	42	-----	42	3,185	-----	300	-----	3,543
Lewis	3	-----	2,506	369	-----	369	48,211	17,500	14,300	-----	46,454
McCoy	1	-----	50	11	-----	11	4	-----	-----	-----	388
New Pass	2	-----	140	108	-----	108	46	-----	-----	-----	3,810
Reese River	5	-----	814	27	-----	27	14,992	300	900	-----	10,708

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 8 and 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: 4,352,263 ounces from lode mines and 3,208 ounces from placers.

[4] Not reported.

[5] Included under "Combined districts."

[6] Exclusive of lode output, which is included under "Combined districts."

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, 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*	
Lincoln County:											
Atlanta	1		34				477	100	100		$323
Caliente	2		82	68		68	702		1,100		2,884
Comet	3		1,067	109		109	15,857	500	165,500		21,728
Eagle Valley	3		86	42		42	206				1,603
Ferguson	2		126,297	5,369		5,369	20,480	100			201,164
Freiberg	1		90	2		2	1,499				1,039
Groom	1		17				80		13,600		677
Jack Rabbit	3		24,899	222		222	210,482	1,116,300	888,700		294,117
Pahranagat	6		96				2,818	1,600	8,000		2,347
Pioche	11		77,987	1,849		1,849	372,661	5,100	6,428,600	16,828,000	1,409,587
Tempiute	2		491	2		2	13,506	300	6,400		9,125
Lyon County:											
Cambridge	2		59	34		34	2				1,191
Palmyra	3		283	99		99	1,358				4,343
Pine Grove	2		206	74		74	26	300			2,636
Silver City	36	(5)	62,199	10,280	(5)	[7] 10,280	[7] 36,464	300			[7] 383,402
Yerington	6	2	111	19	23	42	32	9,400			2,412
Mineral County:											
Aurora	3		68	16		16	90				618
Bell	3		129	80		80	369		9,100		3,457
Candelaria	1		80	13		13	816		1,400		1,047
Eagleville	1		96	21		21	311				936
East Walker	6	(5)	277	251	(5)	[7] 251	[7] 353	300	1,700		[7] 9,121
Fitting	4		59	166		166	166		700		5,950
Garfield	2		723	243		243	26,722	1,300	27,200		27,158
Hawthorne	11	1	2,012	1,899	3	1,902	6,796	1,200	10,200		71,550
Mountain View	2		45	24		24	8				845
Pilot Mountain	4		531	60		60	338		300		2,332
Rand	5		949	254		254	10,723		1,900		15,909
Regent	11	1	910	408	34	442	12,068				23,272
Santa Fe	3		52	25		25	178		300		1,004
Silver Star	30		2,863	2,630		2,630	5,605	1,200	13,200		96,398
Nye County:											
Athens	1		1,516	638		638	293				22,519
Bellehelen	4		87	52		52	1,044		1,100		2,546
Bullfrog	17		1,738	598		598	594	600			21,373
Cloverdale		2			24	24	14				849
Currant	1		1	2		2	2				71
Eden	2		303	3		3	50				137
Fairplay	2		17	6		6	243				367
Golden Arrow	1		36	8		8	768				776

Hannapah	1		1				79				51
Jackson	7		170	137		137	417		100		5,069
Johnnie	3	1	415	97	40	137	29				4,814
Lodi		1			1	1					35
Mammoth	4		203	74		74	731	2,900	7,600		3,696
Manhattan	18	30	22,701	10,679	2,149	12,828	4,675				452,002
Millett	4		198	40		40	6,352		11,000		6,012
Morey	1		50	6		6	2,459				1,800
Quartz Mountain	2		480	144		144	7,731	2,500	109,100		15,301
Reveille	1		352	13		13	5,196				3,814
Round Mountain	6	2	1,962	742	1,698	2,440	2,478				87,002
San Antone	2		57	25		25	1,686		4,700		2,181
Silverton	1		51	1		1	442				321
Tonopah	14		19,598	9,181		9,181	715,266		21,600		784,723
Troy	1		800	219		219	44				7,693
Tybo	1		1,302	212		212	30,988				27,453
Union	4	(5)	153	19	(5)	[7] 19	[7] 4,355		4,800		[7] 3,701
Ormsby County: Carson City	1		1	3		3	4				108
Pershing County:											
Antelope	14	5	878	264	153	417	6,387	6,200	67,300		22,427
Arabia	1		5				99		2,500		179
Buena Vista	1		920	26		26	8,526				6,422
Central	3		351	20		20	12,183	300	12,600		9,185
Echo	1		1	2		2	1				71
Haystack	1		511	631		631	144				22,178
Hualipi	1		45	115		115	173	100	2,500		4,262
Imlay	2	7	188	93	189	282	1,420		1,100		10,839
Kennedy	3		192	205		205	2,928	5,000	1,400		9,622
Pawsupp	1		8	2		2					70
Placerites		2			14	14	3				492
Rochester	13	3	975	370	7	377	8,658	600	6,900		19,168
Rosebud	3	(4)	504	457	413	870	3,974				33,019
Seven Troughs	6		1,513	655		655	489				23,241
Sierra	7	1	1,234	258	1	259	2,815	1,800	1,700		11,139
Trinity	1		2	1		1	23				50
Willow Creek	1		23	84		84	44				2,968
Storey County: Comstock	36	2	397,415	39,182	99	39,281	583,645	4,000	4,000		1,752,717
Washoe County:											
Galena	4		128	10		10	946		8,200		1,339
Granite Range	1		838	340		340	1,844				13,092
Jumbo		1			2	2	32				91
Peavine	1		44	4		4	1,033	1,200	3,800		1,100
Pyramid	2		175	15		15	305	8,800			1,585
Wedekind	1		32	2		2	1,050				749
White Horse	17	2	1,296	602	95	697	318				24,600

[4] Not reported.
[5] Included under "Combined districts."
[7] Exclusive of placer output, which is included under "Combined districts."

Mine production of gold, silver, copper, lead, and zinc in Nevada in 1938, 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					
White Pine County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Aurum	6		725	13		13	14,616	17,900	27,700		$12,932
Black Horse	1		2				24				16
Cherry Creek	17		13,652	1,974		1,974	123,878		8,700		149,573
Eagle	2		119	9		9	1,258	500	25,500		2,350
Granite	4		316	238		238	125		30,600		9,818
Newark	1		214	3		3	3,253				2,208
Osceola	8	7	3,328	2,113	987	3,100	1,819		600		109,704
Robinson	39		3,997,090	49,673		49,673	535,268	77,001,600	65,700		9,633,766
Taylor	1		243	4		4	1,433				1,066
Ward	2		67	6		6	488				525
White Pine	5		5,005	121		121	24,576		31,200		21,558
Combined districts [8]	6	6	17,868	5,745	89	5,834	23,496		1,000		219,431
Total Nevada	795	130	5,880,021	283,475	12,959	296,434	4,355,471	92,338,000	9,358,000	17,888,000	23,529,064

[8] Includes following: Leonard Creek, Paradise Valley, and Sawtooth (lode) in Humboldt County; Silver City (placer) in Lyon County; East Walker (placer) in Mineral County; Phonolite and Union (placer) in Nye County; and Loring in Pershing County.

CHURCHILL COUNTY

Dixie Valley district.—The Comstock-Keystone Mining Co. treated 1,700 tons of impounded amalgamation tailings in 1938 by cyanide leaching at its Dixie mine between September 1 and the end of the year.

Fairview district.—The Nevada Hills mine was worked by Nevada Range Mines, Inc., and lessees in 1938; a substantial quantity of silver and gold was produced. The Reorganized Silver King Divide Mining Co. shipped gold-silver ore from the Road Runner mine to smelters.

Sand Springs district.—The treatment of 189 tons of ore from the Dan Tucker and Summit King mines in 1938 yielded 155 ounces of gold and 5,762 ounces of silver; all the ore was shipped, part to a smelter and the remainder to a custom cyanide plant. It is of interest to recall that during the early days of the Comstock Lode salt recovered from a dry lake in the Sand Springs district was transported by camels to the Lode for mills using the Washoe process.

Wonder district.—Lessees at the Nevada Wonder mine in 1938 shipped 1,419 tons of smelting ore, which contained 573 ounces of gold and 39,242 ounces of silver. Several other operations, all small, were reported in the Wonder district.

CLARK COUNTY [3]

Crescent district.—During 1938 a lessee of the Paden mine shipped 189 tons of smelting ore which contained 2 ounces of gold, 7,244 ounces of silver, and 4,849 pounds of lead.

Eldorado Canyon district.—The El Dorado Rover Mining Co. worked the Flagstaff, Rover, and Skylark groups throughout 1938; the company 100-ton cyanide plant was completely rebuilt, and a large quantity of gold-silver ore was treated. The Diamond Gold Mining Co., which operated the Techatticup mine, enlarged its flotation mill by 30 tons to a daily capacity of 90 tons; the ore yielded a gold-lead concentrate which was shipped to a smelter. The ore mined by W. W. Hartman at the Wall Street mine was treated by amalgamation and flotation; the resulting concentrates were shipped to a smelter.

Searchlight district.—Lessees produced a substantial quantity of gold ore at the Blossom mine during the early months of 1938, but litigation suspended operations later in the year. The Duplex mine was worked by lessees throughout 1938; 84 tons of ore contained 151 ounces of gold, 169 ounces of silver, 6,087 pounds of lead, and 1,496 pounds of copper. Lessees shipped ore from the M & M mine to custom cyanide mills and smelters for treatment. In addition to shipping material from a clean-up of the mill, lessees of the Quartette mine shipped a substantial quantity of ore to smelters and custom mills. Other properties in the Searchlight district were operated on a small scale, mostly by lessees.

Yellow Pine district.—The Barefoot Lease, operator of the Barefoot and Golden Chariot mines in 1938, treated 1,020 tons of ore from the Barefoot mine by amalgamation and flotation and shipped 1,141 tons of ore and 25 tons of concentrates to smelters; 1,966

[3] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Clark County, Nev.: Bureau of Mines Inf. Circ. 6964, 1938, 81 pp.

ounces of gold were recovered. A smelter shipment of 59 tons of ore from the Golden Chariot mine contained 154 ounces of gold, 30 ounces of silver, and 2,295 pounds of copper. The Chiquita Mining Co., Ltd., operated the Chiquita mine throughout the year; 21,789 tons of gold ore treated by amalgamation, cyanidation, and gravity concentration contained 8,179 ounces of gold, 526 ounces of silver, 3,298 pounds of copper, and 709 pounds of lead. Lessees of the Root Zinc mine on Bonanza Hill shipped 708 tons of zinc-lead ore, containing 473,334 pounds of zinc and 117,958 pounds of lead, and 21 tons of lead ore, containing 20,177 pounds of lead and 278 ounces of silver. The Yellow Pine Development Co. shipped a substantial quantity of zinc-lead ore.

ELKO COUNTY

Centennial district.—Lead concentrates rich in gold were shipped from the Bull Run mine in 1938.

Cope district.—The Mountain City Copper Co. operated its Mountain City mine in 1938 from January 1 to May 31 and from November 1 to December 31. The company was the leading copper producer in Elko County and had the third-largest output of copper in the State. A substantial quantity of high-grade copper ore was shipped for smelting, but the bulk of the output was flotation concentrates from the 400-ton mill. An extensive exploration campaign was reported at the Rio Grande mine by the Rio Grande Copper Co., subsidiary of the Sunshine Mining Co. of Idaho; no shipments were made.

Cornucopia district.—Old tailings containing gold and silver were shipped from the Cornucopia district in 1938.

Delano district.—Silver-lead ore was shipped to a smelter from the Net Nos. 1, 2, 3, and 4 by the Delno Mining & Milling Co. during 1938.

Gold Circle district.—Gold & Silver Circle Mines, Inc., treated by cyanidation in 1938 25,300 tons of gold-silver ore which yielded 2,303 ounces of gold and 53,631 ounces of silver; in addition, 64 tons of gold ore were shipped to a smelter.

Island Mountain district.—Bruneau Gold, Inc., treated 150 tons of ore by amalgamation and flotation during 1938 and recovered 50 ounces of gold and 15 ounces of silver; a 15- to 20-ton pilot stamp and flotation mill was completed on the property.

Jarbidge district.—J. W. Williams, lessee of the Alpha mine, treated in 1938, by amalgamation and cyanidation, 642 tons of ore containing 164 ounces of gold and 669 ounces of silver; operation covered the period May 1 to October 11. The same operator treated 410 tons of ore, mined at the Kookaboora claim, which yielded 97 ounces of gold and 140 ounces of silver.

Lime Mountain district.—In 1938 Lime Mountain Consolidated shipped to a smelter 5,308 tons of ore which contained 2,458 ounces of gold, 7,368 ounces of silver, and 182,701 pounds of copper; the operation was continuous throughout the year.

Mardis district.—Lessees of the Virginia mine in 1938 shipped 42 tons of ore which contained 172 ounces of gold, 145 ounces of silver, and 928 pounds of copper.

Spruce Mountain district.—Leasing and development work at the property of the Missouri Monarch Consolidated Mines Co. during 1938 resulted in the shipment of 297 tons of lead ore which contained 2 ounces of gold, 6,984 ounces of silver, 128,048 pounds of lead, and 837 pounds of copper. Small shipments were made from several other properties in the Spruce Mountain district.

ESMERALDA COUNTY

Desert district.—In 1938 a lessee of the Homestake No. 1 mine of the Gilbert Homestake Gold Mining Co. shipped 156 tons of gold ore which yielded 223 ounces of gold and 280 ounces of silver; 59 tons of the ore were treated at a custom cyanide plant, and 97 tons were smelted.

Divide district.—In 1938 the Tonopah Divide Mining Co. shipped to a smelter 1,133 tons of ore which contained 672 ounces of gold and 23,331 ounces of silver.

Dyer district.—In 1938 Molini Bros. operated the Silver King mine, a new strike 14 miles northwest of Dyer post office on the State line; 48 tons of lead ore shipped for smelting contained 1 ounce of gold, 4,731 ounces of silver, 466 pounds of copper, and 5,309 pounds of lead; most of the ore was mined at the surface.

Goldfield district.—Lessees shipped a small quantity of high-grade gold ore for smelting from the Combination Fraction during 1938. The Eastern Exploration Co. and other lessees shipped 1,551 tons of ore, containing 2,596 ounces of gold, for smelting from the Florence and Merger claims of the Goldfield Deep Mines Co. of Nevada. Lessees worked the property of the Goldfield Consolidated Mines Co. throughout the year; 5,985 feet of development work were done. The Eastern Exploration Co., largest gold producer in the Goldfield district in 1936 and 1937, suspended operations at Goldfield during 1938. The Bradshaw Syndicate, Inc., most productive lessee on the Goldfield Consolidated property, treated 344,000 tons of old tailings by cyanidation to recover 3,545 ounces of gold and 2,713 ounces of silver between April 6 and December 18; the 1938 season marked the beginning of a program for the re-treatment of 1,600,000 tons of tailings discharged during earlier operations of the company.

Hornsilver district.—In 1938 a lessee of the Empress and Gold Bug mines, 40 miles south of Goldfield, shipped to smelter 172 tons of ore which contained 210 ounces of gold, 276 ounces of silver, 183 pounds of copper, and 6,367 pounds of lead. The Ohio Mines Corporation worked the Goldpoint and Tokop (Orleans group) mines throughout the year; the ore was treated by cyanidation in the 50-ton cyanide mill of the company.

Lone Mountain district.—The Weepah Nevada Mining Co. exhausted its known ore reserves at the Weepah mine and began during 1938 to re-treat flotation tailings; 81,871 tons of ore and 26,468 tons of old tailings were cyanided to recover 11,253 ounces of gold and 24,211 ounces of silver.

Silver Peak district.—A small quantity of high-grade gold ore was shipped to a smelter from the Brodie mine in 1938. Gold ore for smelting was shipped from the Coyote mine also. The Black Mammoth Consolidated Mining Co., operator of the Mary mine, was the largest producer (in terms of gold output, tonnage of ore, and total value of production) in the Silver Peak district; in 1938 the company purchased the Mary mine, which it had formerly operated under lease from the Pittsburg Silver Peak Gold Mining Co. The company operated its 100-ton cyanide mill. A part of the company property was worked independently by the Prescott Lease, which built a 300-ton amalgamation and flotation mill. Desert Silver, Inc., treated 69,678 tons of ore from the Nivloc mine in 1938 at its 175-ton all-slime cyanide mill to recover 2,709 ounces of gold and 768,280 ounces of silver, drove 5,521 feet of development headings, and built a precious-metal refinery; the company was the largest silver producer in the State. The Gold Wedge Divide Mining Co. treated part of its ore by cyanidation and shipped part to a smelter.

EUREKA COUNTY [4]

Buckhorn district.—In 1938 lessees shipped to a smelter from the Ace No. 3 claim 2,792 tons of Buckhorn dump ore which contained 551 ounces of gold and 4,489 ounces of silver.

Cortez district.—The Cortez Metals Co. shipped silver ore from its property in 1938 for smelting. The most productive operation in the Cortez district was in the Mill Canyon section, where the property formerly worked by the Roberts Mining & Milling Co. was taken over by Greenan & Co., Inc.

Diamond district.—Smelter shipments from the Diamond district in 1938 included silver ore from the Wynona mine and silver-lead ore mined by the Summit Peak Mining Co.

Eureka district.—In 1938 the Eureka Prospect Co. shipped to smelters from the Diamond-Excelsior mines 1,374 tons of gold-silver ore containing 355 ounces of gold, 13,010 ounces of silver, 1,348 pounds of copper, and 88,826 pounds of lead; the mine was closed down except for leasing. Cardinalli & Frank (lessees) and sublessees on the property of Eureka Mines, Inc., shipped 310 tons of lead ore for smelting; the ore contained 97 ounces of gold, 6,056 ounces of silver, and 58,528 pounds of lead. The Eureka Corporation, Ltd., worked several properties in the Eureka district and shipped the output to smelters; gold-silver ore was shipped from the Helen, Jackson, and Phoenix mines and gold ore and lead ore from the Richmond-Eureka mine. Gold ore was shipped from the Silver Conner mine and gold-silver old tailings from the Windfall tailings pile. Several smaller producers in the district reported smelter shipments.

Lynn district.—A number of placer and lode properties were active in the Lynn district in 1938; however, the output of the most productive, a placer property, was only 55 ounces of gold.

Safford district.—A small smelter shipment of silver-lead ore mined during 1938 was made from the Morning Glory property.

HUMBOLDT COUNTY [5]

Awakening district.—The Alabama mine was worked by the Alabama Syndicate, lessee, from March 15 to August 31, 1938. A large quantity of gold ore from the Jumbo mine was treated by amalgamation; the mine was operated between April 1 and December 31.

[4] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Eureka County, Nev.; Bureau of Mines Inf. Circ. 7022, 1938, 66 pp.

[5] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Humboldt County, Nev.; Bureau of Mines Inf. Circ. 6995, 1938, 54 pp.

Barrett Springs district.—Gold ore from the King Gold No. 3 was treated by amalgamation in 1938. A development campaign at the Pansy Lee mine by West Coast Mines, Inc., resulted in the production of 189 tons of smelting ore which contained 59 ounces of gold, 4,023 ounces of silver, 208 pounds of copper, and 9,240 pounds of lead; 1,850 feet of development work were done in 1938.

Central district.—A number of small shipments of ore and bullion were made from the Central district during 1938.

Gold Run district.—Marigold Mines, Inc., was the leading producer among a number of lode and placer operators in the Gold Run district in 1938.

National district.—The P. H. O'Neil Corporation worked the National mine in 1938; 161 pounds of high-grade gold ore yielded 199 ounces of gold and 212 ounces of silver by barrel amalgamation, 1 ton of smelting ore contained 64 ounces of gold and 105 ounces of silver, and 939 tons of ore treated by flotation yielded 44 tons of concentrate which contained 157 ounces of gold and 3,321 ounces of silver.

Potosi district.—Getchell Mine, Inc., started production at the Getchell mine March 1, 1938, and by the end of the year had established itself as the leading mining enterprise in Humboldt County; the ore was mined in an open pit and delivered to the 600-ton cyanide plant by truck. Oxide ore was treated by slime agitation and sand leaching and sulfide ore by roasting followed by all-slime cyanidation. During the year 4,072 feet of development work were done. On September 21, 1938, the company declared its first dividend.

Varyville district.—Columbia Mines, Inc., shipped gold ore in 1938 for smelting from the Gurney Gordon mine.

Warm Springs district.—Ore mined at the Ashdown property, near the Nevada-Oregon State line, was treated in 1938 by amalgamation; the mine was operated during the last 3 months of the year.

LANDER COUNTY [6]

Battle Mountain district.—In 1938, as in 1937, lessees at the numerous small mines in the Battle Mountain district produced most of the ore shipped for smelting. The Copper Canyon Mining Co., which operated mines of the Copper Canyon Group and the Copper Basin Group, was the leading producer of the district; part of its property was worked on company account and part through lessees; and, in all, 7,564 tons of copper ore, which contained 2,673 ounces of gold, 13,959 ounces of silver, and 776,881 pounds of copper, were shipped for smelting. The company's development program was discontinued in April, awaiting completion of financing, but curtailed operations, principally stoping, were continued through 1938. Treatment of 500 tons of surface material at the Homestead and Lindy Group yielded 111 ounces of gold and 46 ounces of silver. The Buffalo Valley Mines Co. shipped gold ore for smelting from the Honeycomb Group 17 miles south of Valmy. Lessees on the San Miguel mine shipped 1,429 tons of gold ore which contained 1,075 ounces of gold, 2,684 ounces of silver, 2,665 pounds of copper, and 6,109 pounds of lead. Other active lode mines in the district included the Armour, Bailey Day, Bentley, Big Florence, Big Four Annex, Billie Dog, Black Butte Group, Blue Bird,

[6] *See also* Vanderburg, W. O., Reconnaissance of Mining Districts in Lander County, Nev.: Bureau of Mines, Inf. Circ. 7043, 1939, 83 pp.

Buzzard, Gold Butte Group, Gold Cash, Independence, Lucky Strike, Minnie, Morning Star, Snow Storm, and Tomboy. F. C. Madsen recovered 113 ounces of gold by dry washing at the Box Canyon Placers property. Chase & Caldwell took over control and operation of the Dahl Placers mine from the Grand Hills Mining Co. on August 15, 1938; during the year 1,043 ounces of gold and 136 ounces of silver were produced at the property from 6,403 cubic yards of virgin gravel, extracted by drift mining, and 7,000 cubic yards of tailings. Other productive placer properties in the district included the Copper Canyon, Eva B, Guy Davis, Poorman, and Vail.

Bullion district.—E. J. Bumsted operated the Goldacres mine throughout 1938; 8,300 tons of ore were crushed to 2-inch mesh and given a 7-day leach in a 2-pound cyanide solution, and 1,572 ounces of gold and 320 ounces of silver were recovered. Production was recorded from the Gold Quartz mine during the year. The Gray Eagle Mining Co. shipped to smelter from the Gray Eagle mine 913 tons of gold-silver ore which contained 254 ounces of gold, 22,431 ounces of silver, 8,056 pounds of copper, and 47,479 pounds of lead. The Mill Gulch Placer Mining Co. operated a washing plant and dragline and was the largest producer of placer gold in the State. A number of lessees using small-scale hand methods on the Independence and the Triplett Group mines produced substantial quantities of placer gold.

Hilltop district.—Crude ore was shipped during 1938 for smelting from the Blue Dick, Hilltop, Paymaster, and Pittsburg Red Top mines.

Kingston district.—A lessee worked the Kingston mine throughout 1938 and produced 188 tons of gold ore and 100 tons of silver ore containing 42 ounces of gold, 3,185 ounces of silver, and 389 pounds of lead; the gold ore was treated by amalgamation and concentration, and the silver ore and 2 tons of lead concentrate were shipped to a smelter.

Lewis district.—Gold & Silver Circle Mines, Inc., worked the Betty O'Neal mine in 1938; part of the mine output was treated by flotation followed by smelting of concentrates and part was shipped for direct smelting. A lessee on the Dean mine shipped to a smelter 57 tons of ore which contained 145 ounces of gold and 756 ounces of silver. The Calgrason Mining Co., operator of the Treasure Vault mine, shipped to smelter 391 tons of ore which contained 197 ounces of gold, 3,664 ounces of silver, and 13,598 pounds of copper.

Reese River district.—The Austin Silver Mining Co. worked its group of mines (including the Jack Pot, Camargo, Littrell, Eclipse, and North Star) from January 1 to May 1, 1938; material shipped to a smelter included crude silver ore and silver concentrate from ore treated in the company 120-ton flotation mill. During 1938 four stockholders of the company were awarded a judgment against those financing it; this was the first such award rendered under the financiers' liability clause (sec. 11) of the Securities and Exchange Commission Act of 1933.

LINCOLN COUNTY

Comet district.—Lessees shipped lead ore and dry silver old tailings from the Prince mine in 1938.

Ferguson district.—Cyanidation of Delamar tailings by the Caliente Cyanidation Co. was the outstanding activity in the Ferguson district during 1938. Smelter shipments of gold ore by lessees on the Delamar Exploration Co. property were recorded also.

Jack Rabbit district.—The Bristol Silver Mines Co., largest producer in the Jack Rabbit district in 1938, shipped a substantial quantity of mine and dump ore to a smelter; the material yielded silver, copper, lead, and gold.

Pioche district.—The Combined Metals Reduction Co., operator of the Pioche No. 1 mine, was the leading producer of both zinc and lead in Nevada during 1938; the company was also one of the leading silver producers of the State. A small quantity of lead ore was shipped by the company for direct smelting, but most of the output—argentiferous zinc-lead ore—was shipped to the company 600-ton flotation mill at Bauer, Utah, where gold (iron) concentrate, lead concentrate, and zinc concentrate were made. Pioche Mines Consolidated treated a substantial quantity of dump ore from the Raymond and Ely mines by flotation during the first 3 months of the year.

Tempiute district.—Lessees on the Sterling mine of the Tempiute Mining Co. shipped silver ore to a smelter in 1938.

LYON COUNTY

Silver City district.[7]—Lessees shipped ore to custom mills from the Buckeye mine during 1938; some was amalgamated, some was cyanided, and some received both treatments. The Dayton Consolidated Mines Co., operator of the Dayton mine, continued to be the leading producer of both gold and silver in the Silver City district; it operated also the Oest and Kossuth mines in this district, as well as properties in the Comstock district of Storey County. In addition to company ore, a large quantity of custom ore was treated in its cyanide mill. The Dayton Douglas Cyanidation Co. cyanided old tailings in its 100-ton leaching plant at the Douglas tailings dump from April 1 to November 15. Lessees on the Haywood and Montezuma mines shipped ore to custom mills. Ore shipped by lessees on the Silver King mine was cyanided and amalgamated at custom mills. A large quantity of ore from the property of South Comstock Gold Mines, Inc., was treated by amalgamation and flotation; the resulting concentrates were shipped to a smelter. Lessees on the Vivian mine shipped ore to a custom cyanide mill. A lessee on the Wonder Extension mine shipped ore to custom mills.

MINERAL COUNTY

East Walker district.—Several small outputs of gold ore from the East Walker district were recorded in 1938. The Eureka mine was the largest gold producer.

Fitting district.—High-grade gold ore was produced at the Western Duke claims during 1938; part of the material was treated by amalgamation and part shipped to a smelter.

Garfield district.—The New Eldorado Mines Co. shipped gold-silver ore in 1938 for smelting from the Garfield mine. Lessees shipped gold-silver ore for smelting from the Mabel mine.

[7] *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.

Hawthorne district.—The Nevada Miners Trust Estate leased the Silent Partner Group to the Borealis Mines Trust Estate June 16, 1938; the lessee shipped 792 tons of gold ore to a custom cyanide mill, where 610 ounces of gold and 1,008 ounces of silver were recovered; construction of a 25-ton cyanide leaching plant was begun at a site 1 mile southwest of Fletcher. Gold ore was shipped to a custom cyanide mill and a smelter from the Ashby Gold Mines Co. property in 1938.

Rand district.—The Nevada Rand Mining Co. held a lease and option on the Nevada Rand mine for part of 1938, during which time gold-silver ore was shipped to a smelter and a custom cyanide plant.

Regent district.—Gold ore from the Heckla mine was shipped to a smelter and a custom cyanide plant in 1938. Smelter shipments were also made from the Wild West mine.

Silver Star district.—A lessee on the Fortuna, Keystone, and Hardscrabble mines in 1938 shipped to custom plants 110 tons of ore which yielded 100 ounces of gold and 74 ounces of silver. Shipments from the Mary Ann mine yielded substantial quantities of gold. Bullion and gold ore were shipped from the Sunset mine.

NYE COUNTY

Athens district.—The Warrior was the only mine in the Athens district from which production in 1938 was reported.

Bullfrog district.—The U. S. Milling Corporation worked the Polaris mine during 1938; a 100-ton flotation mill was reported to have been built by the company.

Manhattan district.—Lessees on the Jumping Jack Merger property treated 1,200 tons of old tailings by amalgamation in 1938 and recovered 106 ounces of gold and 47 ounces of silver. Ore mined by lessees at the property of the Manhattan Consolidated Mines Development Co. was treated by flotation, and the concentrates were shipped for smelting. Lessees worked the property of the Nevada Coalition Gold Mines Co. Production was recorded from the Sunday No. 2 mine of the Manhattan Gold Mines Co. The Reliance Mining Co., operator of the Verden mine, was the largest producer in the Manhattan district in 1938. Lessees shipped 3,277 tons of gold ore from the White Caps mine; the ore yielded 3,171 ounces of gold and 173 ounces of silver. Gold was reported produced at the Ajax mine, which was worked by small-scale hand methods. The Manhattan Gold Dredging Co. installed an electric dredge, having one hundred and eight 9½-cubic foot buckets, on the Gold Bench and Gold Bench No. 1 claims 4 miles west of Manhattan; dredging started November 15, and 459,792 cubic yards of gravel had been handled by the end of the year. This was the first dredge of the connected-bucket type to operate in Nevada in a number of years. Lessees on the Jack drift placer produced a substantial quantity of gold. Sluicing operations at the Little Grey mine produced a sizable output of gold between April 1 and the end of the year. Between January 3 and May 30, 123 ounces of gold were produced at the Manhattan No. 1 placer property from 840 cubic yards of gravel. Several lessees treated 1,633 cubic yards of gravel from the Orphant drift placer and recovered 190 ounces of gold.

Millett district.—Shipments (152 tons) of silver ore from the Grant mine in 1938 contained 23 ounces of gold, 6,064 ounces of silver, and 11,505 pounds of lead; a tramway and ore bins were constructed.

Phonolite district.—Lessees shipped 228 tons of ore from the Derelick mine to a custom cyanide mill and a smelter during 1938; 126 ounces of gold and 6,074 ounces of silver were recovered. The Penelas Mining Co., second largest producer in Nye County, operated its mine and 50-ton cyanide mill throughout the year.

Quartz Mountain district.—A lessee worked the Sàn Rafael mine during 1938.

Round Mountain district.—Gold Hill Mines, Inc., worked the Gold Hill mine from June 1 to December 1, 1938; 1,015 tons of ore were treated in the company 100-ton cyanide plant and 74 tons were shipped to a smelter; the total metal yield was 410 ounces of gold and 1,002 ounces of silver. The leading producer in the Round Mountain district in 1938 was the Nevada Porphyry Gold Mines Co., which operated the placer section of its property by hydraulicking from March 22 to August 10 on company account and for the rest of the year through a lessee.

Tonopah district.—In 1938, from the first of the year until August 1, the Tonopah Belmont Development Co. leased the Tonopah Belmont mine to the Belmont Lease which operated it through sublessees; during the last 5 months of the year the owner leased directly to the miners. In all, 7,028 tons of gold-silver ore shipped to smelters contained 2,574 ounces of gold, 231,830 ounces of silver, and 22,329 pounds of lead. Miscellaneous lessees at the Tonopah Extension mine shipped 250 tons of smelting gold-silver ore which contained 51 ounces of gold and 5,700 ounces of silver. Several sets of lessees produced the entire output of the property of the Tonopah Mining Co. of Nevada in 1938. Ore from the West End mine was shipped by lessees.

Tybo district.—In 1938, from November 1 to the end of the year, lessees shipped to a smelter 1,302 tons of ore containing 212 ounces of gold and 30,988 ounces of silver; the ore was derived largely from old dumps at the Tybo property of the Treadwell Yukon Co., Ltd.

PERSHING COUNTY

Central district.—Lessees shipped 348 tons of silver ore from the Keystone mine to a smelter in 1938; the ore contained 10 ounces of gold, 12,166 ounces of silver, 306 pounds of copper, and 18,089 pounds of lead.

Haystack district.—The Jungo Star Gold Mines Co. shipped 511 tons of ore to a smelter during 1938; the ore contained 631 ounces of gold and 144 ounces of silver.

Hualipi district.—In 1938 lessees on the Bucks Head mine, 19 miles north of Gerlach, shipped to a smelter 45 tons of ore which contained 115 ounces of gold, 173 ounces of silver, 135 pounds of copper, and 2, 656 pounds of lead.

Imlay district.—The largest output in the Imlay district in 1938 came from the Willow Creek drift placer worked by lessees.

Kennedy district.—Gold ore was shipped in 1938 for smelting from the Gold Note mine. Small shipments of ore were reported from the Black Hawk and Sunnyside mines also.

Rochester district.—Gold ore mined at the Looney property during 1938 was treated by amalgamation and concentration. The Wabash Quartz Mining Claim Corporation, Ltd., shipped from the Wabash mine 170 tons of smelting ore containing 1 ounce of gold, 6,774 ounces of silver, 651 pounds of copper, and 9,514 pounds of lead.

Rosebud district.—The Gold Box Mining Co. shipped gold ore from its mine in the Box Canyon section of the Rosebud district during 1938. More than 400 ounces of placer gold recovered by small-scale methods, mostly dry washing, were reported for the Rosebud district.

Seven Troughs district.—Most of the output of the Seven Troughs district in 1938 was credited to various lessees on properties of the Nevada State Gold Mines Co.

STOREY COUNTY

Comstock district.—Several small-scale operators worked parts of the California and Virginia claims of the Consolidated Virginia Mining Co. during 1938; the most productive operation was on dump material removed from the mine in about 1912 and recovered from the Sutro tunnel dump. Sutro Tunnel Coalition, Inc., continued cyaniding gold-silver ore mined at the Crown Point property. During the early months of the year the Arizona Comstock Corporation worked the section of the Comstock Lode covered by the Gould and Curry, Savage, Hale and Norcross, and Chollar-Potosi claims. Later the company went into receivership, and after a period of litigation the Consolidated Sierra Mining & Milling Corporation took over the property; the former company treated a substantial quantity of gold-silver ore, but the latter organization had not begun production at the mines by the end of 1938. The Dayton Consolidated Mines Co. worked the Justice and Keystone mines and hauled the ore by truck to its cyanide plant at the Dayton mine, a mile or two south, in the Silver City district of Lyon County. Storey County Mines, Inc., worked the Overland mine during 1938; a 100-ton cyanide leaching plant was added to the company 40-ton flotation mill. The Consolidated Chollar Gould & Savage Mining Co. worked the Overman mine throughout the year, treated 121,539 tons of ore by amalgamation and flotation, and produced 1,006 tons of concentrate; the bullion contained 395 ounces of gold and 275 ounces of silver, and the concentrates contained 8,892 ounces of gold, 169,815 ounces of silver, and 3,182 pounds of copper. The Silver Hill Mining Co. worked the Silver Hill property (Lucerne-Echo claims) both on company account and through lessees throughout the year; the company mill, which did a substantial custom business, was enlarged to 100 tons daily capacity. Production was recorded from the Succor mine. Sierra Nevada, Ltd., which operated the Sierra Nevada mine, was one of the larger producers in the Comstock district during 1938; a large slide of waste into the company open-cut seriously affected output late in the year.

WASHOE COUNTY

Granite Range district.—In 1938 W. H. Swank and L. E. Donner, owners of the Mountain View mine, shipped to smelter 838 tons of ore which contained 340 ounces of gold and 1,844 ounces of silver.

White Horse district.—The work of several lessees on the Texas No. 2 property made it the most productive in the White Horse district in 1938.

WHITE PINE COUNTY

Cherry Creek district.—Silver ore was shipped from the Black Metal mine to the McGill smelter of the Nevada Consolidated Copper Corporation in 1938. Lessees on the Egan mine shipped gold-silver ore and old tailings to this smelter. The Nevada Standard Mining Corporation, leading operator in the Cherry Creek district in 1938, shipped gold-silver ore. Lessees were active at the Wide West mine.

Granite district.—Lessees at the Stinson mine in 1938 shipped to smelter 182 tons of ore which contained 236 ounces of gold and 68 ounces of silver.

Osceola district.—The Nevada Tex Mining Co. shipped smelting ore from the Gilded Age and Woodman mines during 1938. The Placers Recovery Co., operator of the Hampton hydraulic placer mine, was the leading producer of placer gold in the Osceola district.

Robinson district.—The Consolidated Coppermines Corporation operated throughout 1938. The copper ore, all produced on company account, was shipped to the concentrator of the Nevada Consolidated Copper Corporation at McGill for treatment; various lessees were responsible for the dry ore produced at the company's extensive holdings in the Robinson district. According to the printed annual report of the company for the year ended December 31, 1938, 1,953,215 tons of ore mined on company account yielded 40,140,763 pounds of copper, 20,901 ounces of gold, and 44,163 ounces of silver; 11,562 tons of lessee ore yielded 1,593 ounces of gold, 47,998 ounces of silver, and 2,445 pounds of lead. D. F. Paine worked the Hayes mine, and L. Piombo worked the Jupiter mine. The Ely Gold Mining Co. shipped a substantial quantity of gold ore for smelting from the Revenue mine. The Nevada Consolidated Copper Corporation, operating subsidiary of the Kennecott Copper Corporation and the largest industrial company in Nevada, worked the Ruth mine at Ruth and its open pit at Copper Flat throughout 1938 except for a shut-down from June 15 to August 1; 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 custom work. Gold-silver ore was shipped to the McGill smelter from the Sophie mine. C. Caviglia shipped old tailings from the Steptoe Creek tailings dump for smelting.

White Pine district.—Small quantities of ore and old tailings, containing chiefly silver, were produced at mines in the White Pine district during 1938.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN NEW MEXICO

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The mine production of recoverable gold in New Mexico in 1938 increased in both quantity and total value over 1937, as the price remained the same in both years. The production of recoverable zinc also gained in quantity, but the total value was less than in 1937 because of the reduced average price. The output of recoverable silver, copper, and lead decreased in both quantity and value. The decrease in quantity is attributable almost entirely to curtailment of production by three important producers in the Central district, Grant County; and part of the large decrease in total value of each of these three metals resulted from the decline in average price. There was an increased output of zinc in the Central district; of gold and silver in the Mogollon district, Catron County, and Steeple Rock district, Grant County; and of copper, gold, and silver in the Lordsburg district, Hidalgo County. Production of gold, silver, copper, lead, and zinc from the Pecos mine in the Willow Creek district, San Miguel County, was slightly higher than in 1937.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

The following table shows the number of mines in New Mexico producing gold, silver, copper, lead, and zinc; the annual output from 1934 to 1938; and the total production from 1848 to 1938.

Mine production of gold, silver, copper, lead, and zinc in New Mexico, 1934–38, and total, 1848–1938, 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
1934	153	328	1, 397, 709	27, 307. 01	$954, 380	1, 061, 775	$686, 400
1935	150	234	440, 799	33, 435. 00	1, 170, 225	1, 061, 902	763, 242
1936	136	169	514, 966	33, 037. 00	1, 156, 295	1, 163, 255	900, 941
1937	159	160	4, 191, 092	41, 171. 00	1, 440, 985	1, 243, 766	962, 053
1938	166	164	2, 414, 857	43, 050. 00	1, 506, 750	1, 229, 860	795, 061
1848–1938			(1)	2, 048, 013. 00	45, 014, 648	61, 139, 542	48, 253, 596

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	23, 630, 000	$1, 890, 400	18, 729, 000	$692, 973	53, 043, 000	$2, 280, 849	$6, 505, 002
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
1848–1938	(2) 827, 976	266, 154, 991	(2) 230, 802	22, 110, 531	(2) 514, 299	62, 334, 762	443, 868, 528

[1] Figures not available.
[2] Short tons.

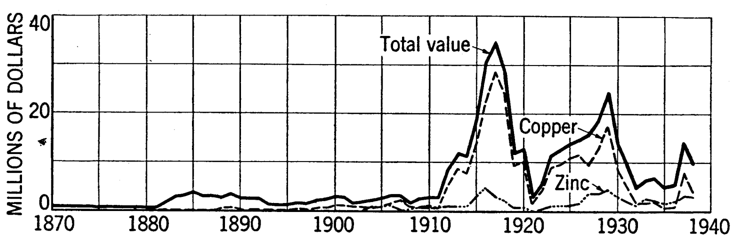

FIGURE 1.—Value of mine production of copper and zinc and total value of gold, silver, copper, lead, and zinc in New Mexico, 1870–1938. The value of gold, silver, and lead produced annually has been relatively small.

Gold and silver produced at placer mines in New Mexico, 1934–38, in terms of recovered metals

Year	Gold		Silver		Total value	Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value			Fine ounces	Value	Fine ounces	Value	
1934	2, 587. 64	$90, 438	212	$137	$90, 575	1937	3, 027. 00	$105, 945	203	$157	$106, 102
1935	3, 554. 40	124, 404	302	217	124, 621	1938	2, 626. 00	91, 910	167	108	92, 108
1936	3, 378. 00	118, 230	235	182	118, 412						

Gold.—The principal gold-producing districts in New Mexico in 1938 were: Willow Creek (Pecos mine), in San Miguel County, which yielded 32 percent of the State total recoverable output of gold; Mogollon, Catron County, 21 percent; Steeple Rock, Grant County, 13 percent; Lordsburg, Hidalgo County, 8 percent; Mount Baldy, Colfax County, 8 percent; and the Hillsboro district, Sierra County (mostly from placers), 6 percent. The table under the heading Review by Counties and Districts lists all the mining districts of the State that produced in 1938 and shows the production of each district. The principal gold-mining districts of New Mexico are described in Information Circular 6987, issued by the Bureau of Mines.[1] Dry and siliceous ores yielded 49 percent of the total gold; zinc-lead ore, 32 percent; copper ore, 12 percent; and placers, together with a small quantity from lead and lead-copper ores, 7 percent.

Silver.—Silver production (in terms of recoverable metal) in New Mexico in 1938 decreased 1 percent from 1937. Substantial increases in the Mogollon, Lordsburg, and Steeple Rock districts were more than offset by a large decrease in the Central district. The Mogollon district produced 35 percent of the State total, Willow Creek 26 percent, Steeple Rock 19 percent, and Lordsburg 11 percent. Dry and siliceous ore, chiefly from the Mogollon and Steeple Rock districts, yielded 59 percent of the total; zinc-lead ore, largely from the Willow Creek and Central districts, 27 percent; copper ore, mostly from the Lordsburg district, 12 percent; and lead-copper and lead ores, together with a very small quantity from placers, 2 percent.

Copper.—The Chino Mines Division of the Nevada Consolidated Copper Corporation at Santa Rita produced the bulk of the State output of recoverable copper in 1938 but reduced its production considerably from that of 1937. The total copper output of New Mexico in 1938 decreased 36 percent in quantity and 48 percent in value from 1937. The second-largest producer of copper in the State in 1938 was the Banner Mining Co., operating the Bonney mine 6 miles south of Lordsburg. Most of the remainder of the copper was recovered in concentrates produced from zinc-lead ore of the Pecos mine at Tererro. Copper ore yielded more than 96 percent of the total copper, zinc-lead ore 3 percent, and other types of ore less than 1 percent.

Lead.—The production of recoverable lead in New Mexico in 1938 decreased 24 percent in quantity and 41 percent in value from 1937. Most of the decrease in quantity was caused by the shut-down of the Ground Hog-San Jose group and Combination mine in the Central district, Grant County, after April 1938. The Pecos mine in the Willow Creek district, San Miguel County, yielded 86 percent of the State total lead in 1938.

Zinc.—The quantity of recoverable zinc in ores and concentrates shipped from New Mexico mines and mills in 1938 increased 18 percent over 1937, but the total value was 13 percent less because of the decline in average price. Two of the large zinc-producing mines—the Pecos at Tererro, San Miguel County, and the Hanover in the Central district, Grant County—were operated continuously in 1938. The Pewabic mine, also in the Central district and an important

[1] Metzger, O. H., Gold Mining in New Mexico: Bureau of Mines Inf. Circ. 6987, 1938, 71 pp.

producer during the year, was in operation from March to June, inclusive, and from October 15 to December 31. The other mines in New Mexico that produced recoverable zinc in 1938—comprising the Ground Hog-San Jose, Combination, and Peerless groups, also in the Central district; Grandview in the Swartz district, also in Grant County; Waldo at Magdalena, Socorro County; and Iron King in the Kingston district, Sierra County—shipped ore for only a few months in the first part of the year.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1938, 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
Bernalillo	1		4.40	$154	3	$2
Catron	6		8,960.40	313,614	429,847	277,881
Colfax	4	8	3,387.40	118,559	1,205	779
Dona Ana	1		112.60	3,941	322	208
Grant	70	22	8,764.80	306,768	307,426	198,740
Hidalgo	29		4,131.60	144,606	138,736	89,688
Lincoln	5	46	167.20	5,852	458	296
Luna	3		397.40	13,909	13,676	8,841
Otero		2	11.60	406	1	1
Rio Arriba	1	1	7.40	259	3	2
Sandoval	2		164.20	5,747	1,700	1,099
San Miguel	1		13,847.20	484,652	322,400	208,420
Santa Fe	8	15	321.20	11,242	2,718	1,757
Sierra	22	69	2,611.20	91,392	9,283	6,001
Socorro	10		108.80	3,808	268	173
Taos	2	1	38.40	1,344	1,409	911
Torrance	1		14.20	497	405	262
	166	164	43,050.00	1,506,750	1,229,860	795,061
Total, 1937	159	160	41,171.00	1,440,985	1,243,766	962,053

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Bernalillo							$156
Catron	500	$49					591,544
Colfax	27,500	2,695	300	$14			122,047
Dona Ana	6,500	637					4,786
Grant	33,161,400	3,249,817	825,400	37,968	33,421,000	$1,604,208	5,397,501
Hidalgo	6,380,400	625,279	159,600	7,342			866,915
Lincoln	100	10	5,800	267			6,425
Luna	6,000	588	256,700	11,808			35,146
Otero							407
Rio Arriba							261
Sandoval							6,846
San Miguel	1,184,000	116,032	8,554,500	393,507	22,581,000	1,083,888	2,286,499
Santa Fe	88,800	8,702	39,400	1,812			23,513
Sierra	17,400	1,705	42,100	1,937	35,000	1,680	102,715
Socorro	700	69	14,200	653	435,000	20,880	25,583
Taos							2,255
Torrance	4,700	461					1,220
	40,878,000	4,006,044	9,898,000	455,308	56,472,000	2,710,656	9,473,819
Total, 1937	64,106,000	7,756,826	13,024,000	768,416	47,854,000	3,110,510	14,038,790

Gold and silver produced at lode mines in New Mexico in 1938, by counties, in terms of recovered metals

County	Ore sold or treated	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*
Bernalillo	11	4.40	3
Catron	64,855	8,960.40	429,847
Colfax	18,941	3,337.40	1,191
Dona Ana	133	112.60	322
Grant	2,004,701	8,580.80	307,392
Hidalgo	113,760	4,131.60	138,736
Lincoln	64	4.20	447
Luna	3,645	397.40	13,676
Rio Arriba	25	1.40	3
Sandoval	276	164.20	1,700
San Miguel	203,900	13,847.20	322,400
Santa Fe	1,374	252.00	2,715
Sierra	857	470.80	9,179
Socorro	1,239	108.80	268
Taos	1,029	36.60	1,409
Torrance	47	14.20	405
	2,414,857	40,424.00	1,229,693
Total, 1937	4,191,092	38,144.00	1,243,563

Gold and silver produced at placer mines in New Mexico in 1938, 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	48.82	14			1.18		50.00	14
Grant	90.27	22			93.73	12	184.00	34
Lincoln	129.95	9			33.05	2	163.00	11
Otero	11.60	1					11.60	1
Rio Arriba	6.00						6.00	
Santa Fe	65.48	3	3.72				69.20	3
Sierra	195.62	11			1,944.78	93	2,140.40	104
Taos	1.80						1.80	
	549.54	60	3.72		2,072.74	107	2,626.00	167
Total, 1937	492.05	62	19.93	3	2,515.02	138	3,027.00	203

[1] Dragline and power-shovel excavators with sluices or special amalgamators.

MINING INDUSTRY

Separation of the 166 lode properties producing 2,414,857 tons of ore in New Mexico in 1938 into groups according to quantity of ore sold or treated shows: 10 mines operated by the larger companies, which have invested much money in equipment, maintain staffs of engineers, geologists, and metallurgists, and employ many men, produced 2,392,329 tons of ore; about 30 mines worked by owners, lessees, and small companies, which employed several men and in general used air compressors, air drills, and gasoline or electric hoists (and in some instances operated small ore-reduction mills), produced about 19,150 tons; and the remaining 126 operations, comprising chiefly individuals working alone or in small groups on widely scattered mines, prospects, and dumps and using man power in their operations, produced about 3,378 tons. The ore produced by the 10 mines in the first group yielded 86 percent of the State total output of gold from lode mines, 91 percent of the silver, 93 percent of the lead, 99 percent of the zinc, and more than 99 percent of the copper.

The output of gold from placers also came mostly from properties equipped for large-scale production; four operators, handling approximately 353,000 cubic yards of gravel during the year and using draglines and power shovels and land washing plants, recovered 79 percent of the State total placer gold. 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.

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 1938, with content in terms of recovered metals

Source	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold ore	26, 149	7, 003. 31	19, 669	93, 719	49, 525	
Dry and siliceous gold-silver ore	82, 017	14, 011. 17	697, 500	37, 545	210, 720	
Dry and siliceous silver ore	523	4. 63	7, 969	1, 090	3, 670	
	108, 689	21, 019. 11	725, 138	132, 354	263, 915	
Copper ore	1, 904, 374	5, 337. 57	150, 094	39, 434, 566	96, 160	
Lead ore	962	193. 12	6, 258	4, 030	239, 125	
Lead-copper ore	303	13. 00	11, 225	45, 000	161, 000	
Zinc ore	182, 822				5, 300	32, 583, 000
Zinc-lead ore	217, 707	13, 861. 20	336, 978	1, 262, 050	9, 132, 500	23, 889, 000
	2, 306, 168	19, 404. 89	504, 555	40, 745, 646	9, 634, 085	56, 472, 000
Total, lode mines	2, 414, 857	40, 424. 00	1, 229, 693	40, 878, 000	9, 898, 000	56, 472, 000
Total, placers		2, 626. 00	167			
	2, 414, 857	43, 050. 00	1, 229, 860	40, 878, 000	9, 898, 000	56, 472, 000
Total, 1937	4, 191, 092	41, 171. 00	1, 243, 766	64, 106, 000	13, 024, 000	47, 854, 000

METALLURGIC INDUSTRY

Most of the ore-reduction plants operating in New Mexico in 1938 were straight flotation mills and were used to treat ores containing all or a large part of their value in copper, lead, and zinc. The Aztec mill in the Mount Baldy district, Colfax County, treated gold-silver-copper ore by flotation but used a jig and amalgam barrel in the ball mill-classifier circuit to recover some of the gold and silver. The Little Fanney mill at Mogollon, Catron County, was the only cyanidation mill in operation in the State during the year.

Mine production of metals in New Mexico in 1938, 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	19, 705	671. 84	136			
Ore cyanided [1]	64, 352	8, 604. 11	424, 174			
Concentrates smelted	146, 061	21, 198. 54	485, 661	40, 567, 850	9, 145, 260	55, 850, 000
Ore smelted	27, 808	9, 949. 51	319, 722	310, 150	752, 740	622, 000
Placer		2, 626. 00	167			
		43, 050. 00	1, 229, 860	40, 878, 000	9, 898, 000	56, 472, 000
Total, 1937		41, 171. 00	1, 243, 766	64, 106, 000	13, 024, 000	47, 854, 000

[1] Cyanide used was 235,600 pounds of Aero Brand calcium cyanide, approximately 48 to 49 percent NaCN.

Construction work on the new copper smelter at the Chino concentrator at Hurley, Grant County, which was in progress throughout 1938, was completed early in 1939, and the smelter began treating Chino concentrates May 2. All markets for other New Mexico ore and concentrates are outside the State.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in New Mexico in 1938, by counties, in terms of recovered metals

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*
Catron	64,352	8,604.11	424,174					
Colfax	18,356	474.60	77	337	2,305.85	820	27,200	
Dona Ana	41	44.60	20	4	9.60	27	400	
Grant	785	56.31	22	183	53.20	1,008	1,200	23,760
Lincoln	30	3.10	1					
Santa Fe	415	60.68	7					
Sierra	12	16.48	2					
Socorro	66	16.07	7	(1)	1.10	1		
	84,057	9,275.95	424,310	524	2,369.75	1,856	28,800	23,760
Total, 1937	77,209	8,348.78	258,167	23	118.86	70		200

[1] Less than ½ ton.

Mine production of metals from concentrating mills in New Mexico in 1938, 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*
Grant	1,986,253	95,120	1,875.00	39,001	33,025,000	434,000	33,234,000
Hidalgo	111,529	13,186	3,065.79	119,145	6,327,000	93,000	
Rio Arriba	25	1	1.40	3			
San Miguel	203,900	37,104	13,847.20	322,400	1,184,000	8,554,500	22,581,000
Sierra	254	103	2.00	2,162	3,050	40,000	35,000
Socorro	15	1	12.30	79			
Taos	1,016	22	25.10	1,015			
	2,302,992	145,537	18,828.79	483,805	40,539,050	9,121,500	55,850,000
Total, 1937	4,057,612	173,807	22,121.19	621,941	61,485,020	11,379,850	46,270,000

Gross metal content of concentrates produced from ores mined in New Mexico in 1938, by classes of concentrates smelted

Class of concentrates	Concentrates produced	Gross metal content				
		Gold	Silver	Copper (wet assay)	Lead (wet assay)	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry gold	16	23.00	120	443	382	
Dry gold-silver	22	25.10	1,015	57	9	
Copper	72,605	7,244.24	146,577	40,709,154	187,189	
Lead	235	47.00	2,863	5,894	69,893	19,038
Lead-copper	12,749	13,070.30	280,543	1,070,962	9,986,640	2,830,645
Zinc	60,434	1,195.40	90,962	506,047	554,897	65,705,428
	146,061	21,605.04	522,080	42,292,557	10,799,010	68,555,111
Total, 1937	173,830	22,737.81	681,893	65,051,836	13,564,988	59,808,582

Mine production of metals from New Mexico concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Colfax	337	2,305.85	820	27,200		
Dona Ana	4	9.60	27	400		
Grant	95,303	1,928.20	40,009	33,026,200	457,760	33,234,000
Hidalgo	13,186	3,065.79	119,145	6,327,000	93,000	
Rio Arriba	1	1.40	3			
San Miguel	37,104	13,847.20	322,400	1,184,000	8,554,500	22,581,000
Sierra	103	2.00	2,162	3,050	40,000	35,000
Socorro	1	13.40	80			
Taos	22	25.10	1,015			
	146,061	21,198.54	485,661	40,567,850	9,145,260	55,850,000
Total, 1937	173,830	22,240.05	622,011	61,485,020	11,380,050	46,270,000

BY CLASSES OF CONCENTRATES SMELTED

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	16	23.00	120	400	340	
Dry gold-silver	22	25.10	1,015			
Copper	72,605	7,244.24	146,577	39,304,600	93,000	
Lead	235	47.00	2,863	3,850	63,420	
Lead-copper	12,749	13,070.30	280,543	858,000	8,988,500	
Zinc	60,434	788.90	54,543	401,000		55,850,000
	146,061	21,198.54	485,661	40,567,850	9,145,260	55,850,000

Gross metal content of New Mexico crude ore shipped to smelters in 1938, by classes of ore

Class of ore	Ore		Gross metal content				
			Gold	Silver	Copper	Lead	Zinc
	Short tons	*Percent of total*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Dry and siliceous gold	7,161	25.75	4,047.75	18,622	70,226	91,994	4,012
Dry and siliceous gold-silver	15,892	57.15	5,282.23	271,284	40,603	214,383	1,229
Dry and siliceous silver	523	1.88	4.63	7,969	1,282	6,480	
Copper	1,383	4.97	408.78	4,364	163,594	6,102	
Lead	962	3.46	193.12	6,258	5,820	266,217	5,342
Lead-copper	303	1.09	13.00	11,225	56,558	178,642	83,806
Zinc	983	3.54				7,556	543,531
Zinc-lead	601	2.16				148,934	233,810
	27,808	100.00	9,949.51	319,722	338,083	920,308	871,730
Total, 1937	56,271	100.00	7,555.57	363,509	2,659,764	2,776,520	4,245,424

Mine production of metals from New Mexico crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Bernalillo	11	4.40	3			
Catron	503	356.29	5,673	500		
Colfax	585	556.95	294	300	300	
Dona Ana	92	58.40	275	6,100		
Grant	17,663	6,596.29	267,361	135,200	367,640	187,000
Hidalgo	2,231	1,065.81	19,591	53,400	66,600	
Lincoln	34	1.10	446	100	5,800	
Luna	3,645	397.40	13,676	6,000	256,700	
Sandoval	276	164.20	1,700			
Santa Fe	959	191.32	2,708	88,800	39,400	
Sierra	591	452.32	7,015	14,350	2,100	
Socorro	1,158	79.33	181	700	14,200	435,000
Taos	13	11.50	394			
Torrance	47	14.20	405	4,700		
	27,808	9,949.51	319,722	310,150	752,740	622,000
Total, 1937	56,271	7,555.17	363,385	2,620,980	1,643,950	1,584,000

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	7,161	4,047.75	18,622	66,119	49,525	
Dry and siliceous gold-silver	15,892	5,282.23	271,284	36,345	186,960	
Dry and siliceous silver	523	4.63	7,969	1,090	3,670	
Copper	1,383	408.78	4,364	157,566	3,160	
Lead	962	193.12	6,258	4,030	239,125	
Lead-copper	303	13.00	11,225	45,000	161,000	
Total to copper and lead plants	26,224	9,949.51	319,722	310,150	643,440	
Zinc	983				5,300	435,000
Zinc-lead	601				104,000	187,000
	27,808	9,949.51	319,722	310,150	752,740	622,000

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REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in New Mexico in 1938, 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*	
Bernalillo County: Coyote	1		11	4.40		4.40	3		3				$156
Catron County: Mogollon	6		64,855	8,960.40		8,960.40	429,847		429,847	500			591,544
Colfax County: Mount Baldy	4	8	18,941	3,337.40	50.00	3,387.40	1,191	14	1,205	27,500	300		122,047
Dona Ana County: Organ	1		133	112.60		112.60	322		322	6,500			4,786
Grant County:													
Burro Mountain	5		338	230.80		230.80	8,186		8,186	1,100	200		13,487
Central	10	3	1,987,688	2,029.40	9.20	2,038.60	52,645	3	52,648	33,114,400	679,500	33,389,000	4,984,526
Gold Hill [1]	5		17	7.20		7.20	187		187		400		391
Lone Mountain	1		1				68		68				44
Pinos Altos	35	15	1,834	626.60	76.40	703.00	7,176	19	7,195	11,900	81,800		34,185
Red Rock	2		3				11		11	700			76
Steeple Rock	11		14,740	5,686.80		5,686.80	239,119		239,119	33,300	38,500		358,654
Swartz	1		80								25,000	32,000	2,686
White Signal		4			98.40	98.40		12	12				3,452
Hidalgo County:													
Gillespie	1		143	2.60		2.60	1,488		1,488	700	23,300		2,194
Gold Hill [1]	3		69	23.60		23.60	51		51	100	3,700		1,039
Lordsburg	20		112,157	3,402.40		3,402.40	134,849		134,849	6,346,300	113,200		833,403
San Simon	1		15	59.60		59.60	20		20		100		2,104
Sylvanite	4		1,376	643.40		643.40	2,328		2,328	33,300	19,300		28,175
Lincoln County:													
Jicarilla		45			162.20	162.20		11	11				5,684
Nogal	4		41	3.20		3.20	195		195		2,300		344
White Oaks	1	1	23	1.00	.80	1.80	252		252	100	3,500		397
Luna County:													
Cooks Peak	2		50				393		393		46,700		2,402
Victorio	1		3,595	397.40		397.40	13,283		13,283	6,000	210,000		32,744
Otero County: Orogrande		2			11.60	11.60		1	1				407
Rio Arriba County: Headstone	1	1	25	1.40	6.00	7.40	3		3				261
Sandoval County: Cochiti	2		276	164.20		164.20	1,700		1,700				6,846
San Miguel County: Willow Creek	1		203,900	13,847.20		13,847.20	322,400		322,400	1,184,000	8,554,500	22,581,000	2,286,499

Santa Fe County:													
Ortiz Mountains (Cerrillos)	1	5	32	16.80	5.00	21.80	20		20	300			805
San Pedro	7	10	1,342	235.20	64.20	299.40	2,695	3	2,698	88,500	39,400		22,708
Sierra County:													
Chloride	4		20	42.20		42.20	594		594	100	400		1,889
Kingston	3		540	3.80		3.80	6,367		6,367	3,300	40,600	35,000	8,120
Lake Valley	1		29				215		215	100	1,100		200
Las Animas (Hillsboro)	14	32	268	424.80	2,072.80	2,497.60	2,003	101	2,104	13,900			90,138
Pittsburg		37			67.60	67.60		3	3				2,368
Socorro County:													
Good Fortune	1		2				1		1	550			55
Hansonberg	1		4	.11		.11	11		11		3,000		149
Magdalena	6		1,181	79.49		79.49	163		163	150	11,200	435,000	24,297
San Mateo Mountains	2		52	29.20		29.20	93		93				1,082
Taos County: Red River	2	1	1,029	36.60	1.80	38.40	1,409		1,409				2,255
Torrance County	1		47	14.20		14.20	405		405	4,700			1,220
Total New Mexico	166	164	2,414,857	40,424.00	2,626.00	43,050.00	1,229,693	167	1,229,830	40,878,000	9,898,000	56,472,000	9,473,819

[1] District lies in both Grant and Hidalgo Counties.

BERNALILLO COUNTY

Coyote district.—Sinking of a 10-foot shaft on each of four newly discovered claims 14 miles east of Albuquerque in sec. 6, T. 9 N., R. 5 E., New Mexico principal meridian, resulted in the shipment of 11 tons of oxidized gold ore to the El Paso smelter in 1938.

CATRON COUNTY

Mogollon district.—The Mogollon was the largest silver-producing district in New Mexico in 1938 and ranked second in gold production. The output of silver increased from 310,450 fine ounces in 1937 to 429,847 ounces in 1938, and gold from 7,559 to 8,960 ounces. The Black Hawk Consolidated Mines Co., the only larger operator in the district in 1938, maintained steady shipments of gold-silver bullion to the Denver Mint throughout the year from the Little Fanney 200-ton cyanide mill at Mogollon. The company holds the mill and the Consolidated group, comprising the Andrew Jackson Consolidated, Lexington Contention, and Lexington Gunboat claims on the Queen vein, under lease from the Lehigh Metals Co. The mill treated 64,352 tons of ore in 1938 compared with 45,508 tons in 1937. In 1938 the mill feed included 4,135 tons of custom ore from the Maud S group and 2,312 tons from the Last Chance, both worked by lessees—the Maud S for the entire year and the Last Chance from April 1 to December 31. Some of the ore produced at the Last Chance group was shipped crude to the El Paso smelter. The 150-ton Deadwood flotation mill, which was run part of 1937 by the Mogollon Consolidated Mines Co., was idle all of 1938. The Bearup mine was operated on a small scale during January, February, and March 1938 and produced about 60 tons of ore, of which 21 tons containing 4.43 ounces of gold and 164 ounces of silver were shipped to the El Paso smelter during the year. Small lots of ore were shipped from two other claims in the district in 1938.

COLFAX COUNTY

Mount Baldy district (*Baldy, Elizabethtown, Eagle Nest*).—The Aztec mine, owned and operated by the Maxwell Land Grant Co., continued in 1938 to be the principal producer in the Mount Baldy district. The ore was treated in the company 140-ton flotation mill. During the year the company installed a jig in the ball mill-classifier circuit and an amalgam barrel to treat the jig concentrates. The yield from 17,831 tons of newly mined ore and 525 tons taken from dumps was 337 tons of concentrates, containing 2,305.85 ounces of gold, 820 ounces of silver, and 28,288 pounds of copper, shipped to the El Paso smelter and amalgam retorts and metallics, containing 474.60 fine ounces of gold and 77 ounces of silver, shipped to the Denver Mint. Some of the ore treated came from the Montezuma mine and Ponil group dumps. Additional ore from the Montezuma mine, operated continuously by I. E. Pippert under lease from the Maxwell Land Grant Co., was shipped to the El Paso smelter. A lessee at the Virginia Hutchinson mine, also owned by the Maxwell Land Grant Co., shipped 2 tons of smelting ore and recovered a few ounces of gold by hand methods. The French Henry mine was under development from July to December. Some placer mining was done on Willow, Ute, and South Ponil Creeks.

DONA ANA COUNTY

Organ district.—The Mormon mine was operated on a small scale in 1938. It is opened by three shafts—one 205 feet, one 150 feet, and one 110 feet deep—but they were accessible in 1938 only to the water level 90 feet from the surface. Stoping and drifting above the water level yielded 48 tons of ore, most of which was treated in a 6-ton amalgamation mill at the mine. The remainder of the ore and some old tailings from previous operations were shipped to the El Paso smelter.

GRANT COUNTY

Burro Mountain district (Tyrone).—The Standard Silver Lead Mining Co. purchased the Malone mine in January 1938 and operated it to the end of the year. The company did 880 feet of development work and shipped gold-silver ore to the El Paso smelter. Small lots of ore were shipped from the Calcutta, Little Wonder, Petanke, and Shamrock properties.

Central district (Bayard, Fierro, Georgetown, Hanover, Santa Rita).—The Chino open-pit mine of the Nevada Consolidated Copper Corporation, an operating subsidiary of the Kennecott Copper Corporation, at Santa Rita is the largest producer of copper in New Mexico. The ore is mined with electric shovels, 11 of which were in use in 1938, and is transported 10 miles over the Atchison, Topeka & Santa Fe Ry. to the company 15,000-ton flotation mill at Hurley for treatment. The concentrates produced contain, besides copper, a little gold and silver and some molybdenite. The separation of molybdenite from the copper concentrates at Chino was first reported in the annual report of the Kennecott Copper Corporation for 1937. The Twenty-Fourth Annual Report of the Kennecott Copper Corporation, dated March 21, 1939, contains the following paragraphs pertaining to its domestic mining operations and Chino property in 1938:

> A total of 16,681,931 tons of ore having a calculated average assay of 1.10 percent copper was treated at the five domestic properties of the Corporation. Copper production amounted to 334,816,884 pounds, a reduction of about 44 percent compared to the 598,733,371 pounds produced in 1937. A relatively heavy stripping program carried on at the power shovel properties in Utah, Nevada, and New Mexico resulted in the removal of approximately 30,225,000 tons of noncommercial overburden. In terms of ratio, 1.95 tons of overburden were removed for each ton of ore mined by shovels at these properties in 1938 whereas in 1937 the ratio was 1.10 tons to 1.
>
> Copper production at the Chino property in New Mexico was suspended from June 22 until October 15 and during the remainder of the year was curtailed in keeping with the general production policy. The new coarse-crushing plant and car dumper operated efficiently. A number of new wells were drilled and a water supply developed which is adequate for the treatment of fully 20,000 tons of ore per day. Construction of the new smelter has progressed without interruption and will be completed in advance of the expiration on March 22, 1939, of the contract with the El Paso smelter which provides that all concentrates produced prior to expiration be shipped to El Paso. Consequently it will probably be May 1 before sufficient concentrates can be accumulated to form a working stock for the steady operation of the new plant. Capital expenditures at the Chino property amounted to $2,622,000, most of this representing outlay on the new smelter.

The Hanover zinc mine and 300-ton flotation mill of the Empire Zinc Co. were operated continuously in 1938. The concentrates produced were shipped to plants of the New Jersey Zinc Co. at Palmerton, Pa., and Depue, Ill. (Mineral Point Zinc Division); to the American Zinc Co., East St. Louis, Ill. (for roasting); and to the American Zinc & Chemical Co., Langeloth, Pa. The Peru Mining Co. operated its Pewabic mine at Hanover and 500-ton mill at Wemple near Deming during March, April, May, and June 1938 and then suspended production. The property was shut down until October 15, when the mine and mill were leased to the Callahan Zinc-Lead Co., which operated them to the end of the year. The mill product is lead-free zinc concentrates, which are roasted at Wemple and shipped to the zinc smelter of the Illinois Zinc Co. (parent company of the Peru Mining Co.) at Dumas, Tex. The mine and mill were again shut down early in 1939 and were still idle when this report was written (May 1939).

The Ground Hog and San Jose mines, operated as a unit by the American Smelting & Refining Co. for the past 10 years, have been important producers of silver, lead, zinc, and copper, and a large part of the ore has been treated in custom mills. In April 1938 the company ceased shipping to the 200-ton Combination custom mill of the Black Hawk Consolidated Mines Co. at Hanover, which had received the bulk of its mill feed from these mines since 1930, and as a result the mill was closed. The Combination mine, operated by the Black Hawk Consolidated Mines Co. from January to April 30, also was closed. Later in 1938 the American Smelting & Refining Co. leased the mill and made some changes necessary for the handling of Ground Hog ore which changed somewhat in character as development proceeded downward to the 1,600-foot level. In April 1939 the mill was placed in operation on company and custom ores. The Peerless Mining & Milling Co. continued developing the Peerless mine from January to June 1938 and shipped zinc-lead-silver ore to the Combination mill and zinc-lead ore to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans. From July 1 to the end of the year the development work was financed by the American Smelting & Refining Co. under an option to purchase. Development as of January 1, 1939, comprised a 330-foot shaft and 1,395 feet of drifts and crosscuts. Ore was shipped direct to smelters from the Hanover-Bessemer Iron & Copper Co. group, Gold Frog group, and one other property in the Central district. Elayer & Matthews, working the Cash and Gold Spot claims near Vanadium, recovered a few ounces of gold by washing ore in a sluice box and also mined some ore to be shipped to the smelter in 1939. Individuals recovered a little gold from small placers in 1938.

Gold Hill district (*see also Hidalgo County*).—Small lots of ore were shipped in 1938 from the Old Spanish, Robert Lee, Silver Dollar, and Yellow Queen claims and a prospect in the Gold Hill district to the El Paso smelter, to Ira L. Wright at Silver City, and to Hawley & Hawley at Douglas, Ariz.

Lone Mountain district.—A lessee at the My Chance claim shipped a 1-ton lot of silver ore in 1938.

Pinos Altos district.—The metal output of the Pinos Altos district in 1938 was derived chiefly from ore produced by many small-scale operations and shipped direct to the El Paso smelter or sold in small lots to Ira L. Wright at Silver City and Hawley & Hawley at Douglas, Ariz. The Calumet 20-ton gravity-concentration mill was operated by lessees part of the year as a custom plant and treated about 580 tons of ore from the Mammouth tailings dump and Campo Santo and Mountain Key mine dumps and 180 tons from the Silver Hill and Ohio mines. Remodeling of the mill to include flotation was completed early in 1939. Other producing mines and dumps included the Bonanza No. 3, Florence, Geo. Schafer, Golden Rule, Hazard, Houston-Thomas, Kept Woman, Langston, Lupita group, Oak Grove, Rich Gulch, and Wild Horse. Individuals continued to work small placers near Pinos Altos intermittently with rockers and sluices.

Red Rock district.—Three tons of copper-silver ore—2 tons from the Friendship claim and 1 ton from the Good Luck—were shipped from the Red Rock district in 1938.

Steeple Rock district.—Shipments of dry and siliceous gold-silver ore from the Steeple Rock district to smelters in Arizona and Texas were continued in 1938. Production from the East Camp group, operated throughout the year by the East Camp Exploration Syndicate, was 8,029 tons of ore averaging 0.36 ounce of gold and 23.71 ounces of silver to the ton; the ore also contains a little copper and lead. The mine is developed by a vertical shaft 300 feet deep, 100 feet of winzes, 1,400 feet of raises, and 3,000 feet of drifts. Veta Mines, Inc., continued to ship newly mined ore and old tailings from the Carlisle group. The ore contains principally gold and silver, with minor quantities of pyrite, galena, chalcopyrite, and sphalerite. As the ore shipped in 1938 went to copper smelters none of the zinc was saved. The section of the mine from which production was made in 1938 is opened by an incline shaft 140 feet deep, 500 feet of drifting, and a 90-foot winze. The old workings on the property were not reopened. Lessees at the Alabama and Laura mines shipped a substantial quantity of ore during the year. Other producers of a car or more of ore in 1938 included the Gold King, Norman King, and Twin Peaks mines.

Swartz (or Carpenter or Camp Monarch) district.—The Black Range Development Co. drove 200 feet of tunnel at the Grandview group 30 miles east of Santa Rita and shipped 80 tons of ore, containing 35,662 pounds of lead and 39,826 pounds of zinc, to the Ozark Smelting & Mining Co. pigment plant at Coffeyville, Kans.

White Signal district.—Placer ground of Sunset Gold Fields, Inc., in Gold Gulch was under development by a lessee from February 1 to December 31, 1938. The property is equipped with a power shovel and portable Ainlay bowl recovery plant, which was run for a period and produced nearly all the metal output of the White Signal district in the year. The remainder was recovered by individuals sluicing at small placers in the same area.

HIDALGO COUNTY

Apache district.—The development work begun in 1937 by the United States Smelting, Refining & Mining Exploration Co. on the Monarch and Copper Crown claims of the Apache group was continued to June 3, 1938, when work was discontinued and the lease terminated.

Gillespie district.—The Red Hill Mining Co. operated the Red Hill group, opened by a 500-foot vertical shaft and several thousand feet of drifts and crosscuts, from July 1 to September 1, 1938, and shipped lead-silver-gold ore to the El Paso smelter.

Gold Hill district (*see also Grant County*).—The Sweet Mining Co. shipped 62 tons of gold-silver-lead ore from a prospect to the El Paso smelter in 1938. The remainder of the output of the Gold Hill district comprised 2 tons of gold-silver ore from the Big Chief claim and 5 tons of gold-silver-lead ore from the Oro Grande.

Lordsburg district.—The Banner Mining Co. operated the Bonney mine and flotation mill 6 miles south of Lordsburg continuously in 1938. Although the company maintained production at a higher rate than in 1937, it proceeded with development of the lower levels of the mine and sank the vertical main shaft an additional 150 feet, giving it a total depth of 1,020 feet at the end of 1938; development work done during the year totaled 6,272 feet. The product of the mill is copper-gold-silver-[iron] concentrates, which are sold to the El Paso smelter. Lessees working the Belle, Depression, Nellie Bly, Silver Dollar, and other properties in the Lordsburg district on a small scale continued to make intermittent shipments of newly mined and sorted dump ore to the El Paso smelter and to Hawley & Hawley at Douglas, Ariz.

San Simon district (*Steins*).—Prospecting and development were continued at the Paint Horse group in 1938, and small lots of high-grade gold ore were shipped.

Sylvanite district.—The Sylvanite Gold Mining Co. operated its Buckhorn-Barney-Woods group 16 miles southwest of Hachita from January 1 to December 15, 1938. Most of the ore produced was shipped direct to the El Paso smelter. The mine is opened by a vertical shaft 200 feet deep, a tunnel, and drifts. It is equipped with a 20-ton concentration mill. A car of silver-lead ore from the Eagle claim and small lots of the same type of ore from the Last Chance and Dodge claims were shipped to the El Paso smelter.

LINCOLN COUNTY

Jicarilla district.—Placer miners continued to recover gold by rocking, sluicing, and drift mining in 1938 in the Jicarilla Mountains southeast of Ancho. At a few placers machinery was used to handle the gravel. Most of the gold produced was sold in small lots to merchants at Jicarilla and Ancho.

Nogal district.—During July 1938 Great Western Mines, Inc., treated in a small amalgamation mill 30 tons of ore from an open-cut on its property. Only 11 tons of ore were shipped to smelters from mines and prospects in the Nogal district in 1938.

White Oaks district.—The Lincoln County Mining & Milling Co. shipped a car of lead-silver-gold-copper ore to the El Paso smelter in 1938, and a little gold was recovered at a placer mine in the White Oaks district.

LUNA COUNTY

Cooks Peak district.—Lead-silver ore was shipped in 1938 from the Lookout mine and Ethel-"85" group to the El Paso smelter and to Ira L. Wright at Silver City.

Deming.—The Peru 500-ton selective flotation mill at Wemple near Deming was operated in 1938 by the Peru Mining Co. at an average daily rate of 330 tons from March to June, inclusive; it was idle from July to October 15, when it was started up under lease by the Callahan Zinc-Lead Co. and treated an average of 323 tons daily to the end of the year. The ore treated by both companies was lead-free zinc sulfide ore from the Pewabic mine at Hanover, Grant County.

Victorio district.—In 1938 Shanks Carpenter continued to ship oxidized gold-silver-lead-[zinc]-iron-lime ore from the Victorio group 4 miles south of Gage to the El Paso smelter. The mine is developed by a 300-foot vertical shaft, a 700-foot adit, and 4,000 feet of other workings.

OTERO COUNTY

Orogrande district.—A lessee worked the Center placer with a dry washer and pan from January 1 to April 15, 1938, and recovered 6.50 ounces of dust 0.915 fine in gold. About the same quantity of gold was recovered from another placer in the Orogrande district in 1938.

RIO ARRIBA COUNTY

Headstone district.—The A. J. S. Mining Co. erected a mill at the Badger-Hidden Treasure group in 1938 and operated it for a short period late in the year. An individual prospecting on placer ground near Tres Piedras recovered a little placer gold.

SANDOVAL COUNTY

Cochiti (Bland) district.—Lessees shipped several cars of gold-silver ore from the Lone Star mine to the El Paso smelter in 1938. A lessee at the old Cossak cyanidation mill cleaned up and shipped to the smelter 4 tons of high-grade gold- and silver-bearing material.

SAN MIGUEL COUNTY

Willow Creek district (Tererro).—The Pecos mine of the American Metal Co. of New Mexico was operated continuously in 1938, its twelfth year of production. The mine has been productive to a depth of 1,700 feet, but the levels below 1,200 feet were abandoned prior to 1938 and operations during 1938 were conducted on levels 1,200 to 400, inclusive. The flow of water continued at an average rate of 1,800 gallons per minute, most of which was pumped from the 1,200-foot level. The ore is treated in the company 600-ton selective flotation mill in Alamitos Canyon. The mill feed in 1938 was 203,900 tons of ore averaging 0.086 ounce of gold and 2.27 ounces of silver to the ton, 0.51 percent copper (wet assay), 2.99 percent lead (wet assay), 8.07 percent zinc, and 11.32 percent iron. The yield was 24,819 tons of zinc concentrates—averaging 0.048 ounce of gold and 3.53 ounces of silver to the ton, 0.96 percent copper (wet assay), 1.03 percent lead (wet assay), 53.52 percent zinc, and 7.53 percent iron—and 12,285 tons of lead-copper concentrates—averaging 1.06 ounces of gold and 21.96 ounces of silver to the ton, 4.08 percent copper (wet assay), 38.68 percent lead (wet assay), 11.08 percent zinc, and 12.32 percent iron. On May 31, 1939, the mine was closed.

SANTA FE COUNTY

Ortiz Mountains district (Cerrillos).—A small output of gold-silver ore was made from the Chord mine in 1938, and some gold was recovered at small placers in the Ortiz Mountains district.

San Pedro or New Placers district.—Lessees at the San Pedro copper mine on the south slope of the San Pedro Mountains 20 miles west of Stanley continued to ship copper-gold-silver ore to the El Paso smelter in 1938. In the first part of the year the mine was purchased by John J. Raskob, who had made geophysical and geological examinations of the mine followed by diamond drilling in 1939. A lessee at the Lincoln-Lucky-Amazon group shipped several cars of lead-silver-gold-copper ore. A few tons of copper-gold-silver ore were shipped from the Delgado and other properties in the San Pedro district. Ore from the Old Timer dump and Captain Davis claim was treated in small amalgamation mills. Most of the output from placers in 1938 was made by lessees sluicing at the Lazarus placer. Individuals continued to recover small lots of dust from other placers.

SIERRA COUNTY

Chloride (Apache, Cuchillo Negro) district.—In 1938 individuals residing at Winston hauled a few truckloads of ore obtained from leasing and prospecting operations in the Chloride district to the El Paso smelter.

Kingston district.—During the first few months of 1938 the lessee on the Iron King mine in the Kingston group of the Empire Zinc Co. continued to ship zinc-lead-silver-copper ore to the Black Hawk Consolidated Mines Co. concentrator at Hanover, Grant County, for treatment. J. H. Moffitt, owner of the Cumberland group, shipped about 7 cars of silver-gold-lead-copper ore to the El Paso smelter. A 2-ton lot of lead ore was shipped to the smelter from another property in the Kingston district.

Lake Valley district.—A car of silver-lead-copper ore was shipped from the Lake Valley group to the El Paso smelter in 1938.

Las Animas district (Hillsboro).—The chief producer of gold in the Las Animas district in 1938, as in each year since 1934, was the John I. Hallett Construction Co. placer operation on a consolidated group of leased properties (including the Gold Dust, Graf Von Luxemburg, and others), 8 miles east of Hillsboro. The equipment consists of two gasoline-powered dragline excavators of 1 and 1¼ cubic yards capacity, a Coulter-Ainlay four-bowl recovery plant mounted on wheels, water-storage tanks, and pumps. Clarence Berg operated a ¾-cubic yard dragline and home-made portable dry-washing plant at the Gordon-Sylvia (or Wilder) placer from March 29 to May 27 and recovered 76 fine ounces of gold. Sluicing, panning, and dry washing at small placers produced some gold.

The Wicks lode mine in Wicks Gulch was shut down from January 1 to October 27, 1938; then it was leased to Drunzer & Everhart, who shipped some ore to the El Paso smelter before the end of the year. Small-scale operations, mostly by lessees, at the Biglow, Bonanza, Duke, El Oro, Gold Coin, Litel King, Lucky Strike, M. K. T., Ready Pay, Sherman, and other properties in the Hillsboro district yielded many small lots of gold-silver-copper ore, which were sold to the El Paso smelter, to Hawley & Hawley at Douglas, Ariz., and to Ira L. Wright at Silver City, N. Mex.

Pittsburg district.—Most of the output of gold and silver from the Pittsburg district in 1938 was contained in small lots of placer dust recovered by individuals sluicing and panning over a considerable area; the dust was marketed through a general store at Hatch.

SOCORRO COUNTY

Good Fortune district (40 miles west of Tularosa).—A lessee worked the Belle Vista prospect during July and August 1938 and shipped a 2-ton lot of oxidized copper ore to the El Paso smelter.

Hansonberg district (17 miles southeast of Carthage).—In 1938 one of the owners of the Louise-Halsbad group worked at the property 30 days in May and June and 6 days in November. The ore shipped contained about 43 percent lead and 2.50 ounces of silver and 0.025 ounce of gold to the ton.

Magdalena district.—During January and February 1938 lessees at the Waldo mine of the Ozark Smelting & Mining Co. continued to ship zinc ore to the company pigment plant at Coffeyville, Kans.; the mine was idle from March to the end of the year. The Mistletoe mine was worked by lessees for a period and produced most of the gold-silver-lead ore shipped from the Magdalena district in 1938. A few lots of ore were shipped from prospects during the year.

San Mateo Mountains district.—The Panky group of the Springtime Mining Co., closed late in 1936, was idle until the last quarter of 1938 when a lessee did some repair work and made several test runs in the mill, resulting in the shipment of about a ton of high-grade gold-silver concentrates. Ellison Warren worked his claim from January to August and installed a 10-ton amalgamation-gravity concentration mill which he removed after having treated a small quantity of ore; he also shipped some gold-silver ore to the El Paso smelter.

TAOS COUNTY

Red River district.—The Memphis mine was operated by a lessee from January to March 1938. The ore produced was treated in a 30-ton gravity- and flotation-concentration mill at Red River; the product was gold-silver concentrates, sold to the El Paso smelter. The Taos Mining & Milling Co. shipped 13 tons of gold-silver ore to smelters in 1938. A little placer gold was recovered by sluicing at a placer in Box Canyon near Red River.

The Molybdenum Corporation of America continued production of 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.

TORRANCE COUNTY

A car of copper-gold-silver ore, presumably from a prospect in the Manzano Range near Abo Pass, was shipped from Scholle to the El Paso smelter in 1938.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN OREGON

(MINE REPORT)

By Charles White Merrill and H. M. Gaylord

SUMMARY OUTLINE

The total value of the gold, silver, copper, and lead produced in Oregon during 1938—$2,935,053—exceeded that in every year, except 1916, since the mining industry was begun in 1852. The total in 1938 was divided as follows: Gold, over 97 percent; silver, over 2 percent; and copper and lead combined, less than 1 percent. No output of zinc was reported for the year. Baker County continued to be the leading metal producer and contributed 46 percent of the State total value; Grant County accounted for 28 percent, Josephine County 16 percent, and Jackson County 9 percent; and the other 10 producing counties made up the remaining 1 percent.

An outstanding feature of the metal-mining industry in Oregon in 1938 was the great expansion in production at the Cornucopia mine, Cornucopia district, Baker County. This mine, the largest lode producer in the State in 1937, increased its gold output 250 percent. The aggregate production from lode mines other than the Cornucopia was considerably less than in 1937.

Another important feature in the State's mining industry during 1938 was the greatly increased yardage of gravel handled by dredges, of both the connected-bucket and dragline types. Operations included 5 connected-bucket and 11 dragline dredges in 1938 compared with 4 of each type in 1937. Production by other placer methods continued to be relatively small.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers. [4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Oregon, 1934–38, and total, 1852–1938, 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
1934	95	332	62,145	33,711.59	$1,178,220	46,560	$30,099
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
1852–1938			(2)	5,317,449.00	114,073,758	4,489,124	4,273,659

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	38,373	$3,070	41,603	$1,539	73,184	$3,147	$1,216,075
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
1852–1938	[3] 12,004	4,561,269	[3] 605	60,215	[3] 140	13,846	122,982,747

[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, 1934–38, 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:					
1934	4	1,912,000	9,254.47	$323,444	$0.169
1935	5	3,440,000	12,720.13	445,205	.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	7,258,226	29,006.00	1,015,210	.140
Dragline dredges: [2]					
1934					
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	2,890,588	15,939.00	557,865	.193

[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 type of power shovel for excavating and delivering gravel to floating washing plant.

Gold produced at placer mines in Oregon, 1934–38, by classes of mines and by methods of recovery—Continued

Class and method	Mines producing	Material treated (cubic yards)	Gold recovered: Fine ounces	Gold recovered: Value	Gold recovered: Average per cubic yard
Surface placers—Continued.					
Gravel mechanically handled—Contd.					
Nonfloating washing plants: [3]					
1934	5	163,000	1,031.47	$36,050	$0.221
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	136,373	1,768.00	61,880	.454
Gravel hydraulically handled:					
Hydraulic:					
1934	37	513,000	2,214.98	77,413	.151
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	730,830	3,261.00	114,135	.156
Small-scale hand methods: [4]					
Wet:					
1934	278	754,032	8,700.26	304,074	.403
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	332,703	3,874.00	135,590	.408
Dry: [5]					
1938	2	800	16.00	560	.700
Underground placers:					
Drift:					
1934	8	2,968	1,038.73	36,304	12.232
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	5,371	467.00	16,345	3.043
Grand total placer:					
1934	332	3,345,000	22,239.91	777,285	.232
1935	268	6,296,000	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	11,354,891	54,331.00	1,901,585	.167

[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 1934–37, 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 1938 increased 55 percent over 1937; the output from placer mines increased 59 percent and that from lode mines 49 percent. Although 241 properties produced in 1938, the bulk of the gold came from relatively few mines; 13 properties produced 80 percent of the total. Of the placer gold, 54 percent was recovered by dredges of the connected-bucket type, 29 percent by dragline dredges, 7 percent by small-scale hand methods, 6 percent by hydraulicking, and the remaining 4 percent by nonfloating washing plants with mechanical excavators and by drift mines. Virtually all the lode gold was derived from dry and siliceous gold ores or from old siliceous tailings. Smelting of concentrates from concentrating and amalgamating mills recovered 72 percent of the lode gold; amalgamation, cyanidation, and direct smelting of ore recovered the remainder. Of the 10 leading gold producers of the State those ranking first, ninth, and tenth were lode mines, and the rest were dredging operations; the operations ranking fourth and sixth employed dragline dredges and the others connected-bucket dredges.

Silver.—Silver production in Oregon in 1938 increased 66 percent in quantity and 39 percent in value over 1937. Baker County yielded 87 percent and Grant County 10 percent of the State total; dry and siliceous gold ore yielded 87 percent and placer gravels 8 percent; and concentration followed by smelting of the resulting concentrates recovered 85 percent of the total. Almost three-fourths of the silver produced in Oregon in 1938 from both lode and placer properties came from the Cornucopia mine, Cornucopia district, Baker County.

Copper, lead, and zinc.—Since cessation of operations by the Balm Creek Gold Mining Co. in Baker County and closing of the Silver Peak mine in Douglas County, production of copper in Oregon has been negligible. Likewise, quiescence of the Bohemia district in Lane County eliminated production of zinc in Oregon and had nearly the same effect on the lead output of the State.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Oregon in 1938, by counties, in terms of recovered metals

County	Mines producing [1]		Gold						Silver (lode and placer) [2]	
	Lode	Placer	Lode		Placer		Total			
			Fine ounces	Value	Fine ounces	Value	Fine ounces	Value	Fine ounces	Value
Baker	23	29	22,478	$786,730	14,301	$500,535	36,779	$1,287,265	86,997	$56,240
Coos		5			114	3,990	114	3,990	18	12
Curry	2	6	101	3,535	85	2,975	186	6,510	14	9
Douglas	2	8	36	1,260	326	11,410	362	12,670	40	26
Grant	19	28	1,146	40,110	22,501	787,535	23,647	827,645	9,934	6,422
Harney	1	1	2	70	10	350	12	420	2	1
Jackson	21	25	940	32,900	6,434	225,190	7,374	258,090	1,678	1,085
Josephine	11	49	2,671	93,485	10,371	362,985	13,042	456,470	1,774	1,147
Lane	3		15	525			15	525	9	6
Malheur		3			146	5,110	146	5,110	27	17
Marion	2	(3)	9	315	2	70	11	385	9	6
Morrow		1			1	35	1	35		
Union		1			11	385	11	385		
Wheeler		1			29	1,015	29	1,015	5	3
	84	157	27,398	958,930	54,331	1,901,585	81,729	2,860,515	100,507	64,974
Total, 1937	104	150	18,443	645,505	34,219	1,197,665	52,662	1,843,170	60,564	46,846

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Baker	74,000	$7,252	42,000	$1,932			$1,352,689
Coos							4,002
Curry							6,519
Douglas							12,696
Grant	2,000	196	2,000	92			834,355
Harney							421
Jackson			2,000	92			259,267
Josephine							457,617
Lane							531
Malheur							5,127
Marion							391
Morrow							35
Union							385
Wheeler							1,018
	76,000	7,448	46,000	2,116			2,935,053
Total, 1937	820,000	99,220	218,000	12,862	48,000	$3,120	2,005,218

[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: 1938, 92,206 ounces from lode mines and 8,301 ounces from placers; 1937, 55,540 ounces from lode mines and 5,024 ounces from placers.

[3] Not reported.

MINING INDUSTRY

Of the 61,278 tons of ore sold or treated in Oregon during 1938, all but 364 tons was dry and siliceous gold ore; the 13,658 tons of old tailings treated contained no substantial values other than gold. Thus, the great importance to Oregon of gold priced at $35 an ounce is apparent. The increase in Oregon gold production during the last decade has come from relatively few properties. Of the lode gold in 1938, more than two-thirds came from a single property—the Cornucopia mine, Cornucopia district, Baker County. Of the placer gold, two-thirds was recovered by the following five operators: The Sumpter Valley Dredging Co. (connected-bucket dredge), Sumpter district, Baker County; Western Dredging Co. (connected-bucket dredge), Canyon district, Grant County; Ferris & Marchbank (dragline dredge), Canyon district, Grant County; Rogue River Gold Co. (connected-bucket dredge), Greenback district, Josephine County; and B-H Co. (dragline dredge), Upper Applegate district, Jackson County. The foregoing six properties contributed two-thirds of the total value of the State output of gold, silver, copper, and lead in 1938.

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 1938, with content in terms of recovered metals

Source	Material sold or 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	60,914	13,658	27,281	87,053	73,834	44,234	
Dry and siliceous gold-silver ore	351		89	4,903	1,506	1,468	
Dry and siliceous silver ore	2			200			
	61,267	13,658	27,370	92,156	75,340	45,702	
Copper ore	9		10	4	660		
Lead ore	2		18	46		298	
Total, lode mines	61,278	13,658	27,398	92,206	76,000	46,000	
Total, placers			54,331	8,301			
	61,278	13,658	81,729	100,507	76,000	46,000	
Total, 1937	70,923	6,307	52,662	60,564	820,000	218,000	48,000

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Dry and siliceous gold ore and old tailings sold or treated in Oregon in 1938, by counties, with content in terms of recovered metals

County	Material sold or treated		Gold	Silver	Copper	Lead	Zinc
	Ore	Old tailings					
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Baker	46,882	4,448	22,468	83,746	72,340	42,000	
Curry	152		101	6			
Douglas	26		36	7			
Grant	2,573		1,057	1,987	494	532	
Harney	9		2				
Jackson	2,485	100	922	641		1,702	
Josephine	8,676	8,800	2,671	648			
Lane	5	310	15	9			
Marion	106		9	9			
	60,914	13,658	27,281	87,053	73,834	44,234	
Total, 1937	68,093	6,307	17,429	49,272	533,300	212,600	48,000

METALLURGIC INDUSTRY

Of the 74,936 tons of ore (including 13,658 tons of old tailings) sold or treated in 1938 in Oregon, 51,339 tons (including 4,448 tons of old tailings) were produced in Baker County; Josephine County produced 17,476 tons, of which 8,800 tons were old tailings. Of the total, 61 percent was treated in concentrating mills, most of which used flotation; 37 percent was treated in amalgamation and cyanidation mills, with or without concentration equipment; and the remainder was shipped crude for smelting. Seventy-two percent of the lode gold was recovered ultimately by the smelting of concentrates; 11 percent as bullion by amalgamation of ore and old tailings; 10 percent by cyanidation of ore, concentrates, and old tailings; and 7 percent by direct smelting of ore. All material requiring smelting was shipped out of the State, as Oregon has no smelters.

Mine production of metals in Oregon in 1938, 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	6,461	2,952	608			
Ore, concentrates, and old tailings cyanided	21,193	2,611	592			
Concentrates smelted:						
Flotation	1,979	19,522	85,026	72,604	44,267	
Gravity	55	250	289	716	328	
Ore smelted	1,420	2,063	5,691	2,680	1,405	
Total, lode mines		27,398	92,206	76,000	46,000	
Total, placers		54,331	8,301			
		81,729	100,507	76,000	46,000	
Total, 1937		52,662	60,564	820,000	218,000	48,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Oregon in 1938, 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	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
AMALGAMATION MILLS										
Baker	2,278	--------	1,588	255	7	17	14	716	--------	--------
Curry	152	--------	101	6	--------	--------	--------	--------	--------	--------
Douglas	26	--------	36	7	--------	--------	--------	--------	--------	--------
Grant	868	--------	301	78	3	2	17	--------	--------	--------
Harney	9	--------	2	--------	--------	--------	--------	--------	--------	--------
Jackson	2,083	--------	689	207	29	167	215	--------	--------	--------
Josephine	579	50	218	43	4	31	12	--------	--------	--------
Lane	--------	310	8	3	--------	--------	--------	--------	--------	--------
Marion	106	--------	9	9	--------	--------	--------	--------	--------	--------
	6,101	360	2,952	608	43	217	258	716	--------	--------
Total, 1937	11,583	7	2,231	735	462	1,067	3,449	19,000	145,600	48,000
CYANIDATION MILLS										
Baker	146	3,100	236	36	--------	--------	--------	--------	--------	--------
Grant	1,030	--------	204	43	--------	--------	--------	--------	--------	--------
Jackson	--------	100	13	9	--------	--------	--------	--------	--------	--------
Josephine	8,067	8,750	2,158	504	--------	--------	--------	--------	--------	--------
	9,243	11,950	2,611	592	--------	--------	--------	--------	--------	--------
Total, 1937	3,187	3,800	761	224	--------	--------	--------	--------	--------	--------
Grand total: 1938	15,344	12,310	5,563	1,200	43	217	258	716	--------	--------
1937	14,770	3,807	2,992	959	462	1,067	3,449	19,000	145,600	48,000

[1] Ore figures, include concentrates cyanided.

Mine production of metals from concentrating mills in Oregon in 1938, 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	44,010	1,348	1,955	19,441	82,729	72,449	41,425
Grant	250	-----------	26	63	2,123	155	1,468
Jackson	400	-----------	10	51	205	---------	1,702
	44,660	1,348	1,991	19,555	85,057	72,604	44,595
Total, 1937	52,691	2,500	5,184	12,363	42,765	513,300	66,300

Gross metal content of concentrates produced from ores mined in Oregon in 1938, 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	2,001	19,692	83,178	74,190	68,343	----------
Dry gold-silver	26	63	2,123	238	1,530	----------
Copper	7	17	14	738	----------	----------
	2,034	19,772	85,315	75,166	69,873	----------
Total, 1937	5,646	13,430	46,214	560,718	240,670	67,973

Mine production of metals from Oregon concentrates shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Baker	1,962	19,458	82,743	73,165	41,425	
Grant	29	65	2,140	155	1,468	
Jackson	39	218	420		1,702	
Josephine	4	31	12			
	2,034	19,772	85,315	73,320	44,595	
Total, 1937	5,646	13,430	46,214	532,300	211,900	48,000

BY CLASSES OF CONCENTRATES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
Dry gold	2,001	19,692	83,178	72,449	43,127	
Dry gold-silver	26	63	2,123	155	1,468	
Copper	7	17	14	716		
	2,034	19,772	85,315	73,320	44,595	

Gross metal content of Oregon crude ore shipped to smelters in 1938, 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	1,306	2,009	2,661	1,221	1,663
Dry and siliceous gold-silver	101	26	2,780	1,363	
Dry and siliceous silver	2		200	54	20
Copper	9	10	4	826	
Lead	2	18	46		314
	1,420	2,063	5,691	3,464	1,997
Total, 1937	3,462	2,021	8,367	297,592	8,001

Mine production of metals from Oregon crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Baker	603	1,196	716	835	575
Grant	778	576	4,829	1,845	532
Jackson	4	20	51		298
Josephine	30	264	89		
Lane	5	7	6		
	1,420	2,063	5,691	2,680	1,405
Total, 1937	3,462	2,021	8,367	287,700	6,100

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous gold	1,306	2,009	2,661	669	1,107
Dry and siliceous gold-silver	101	26	2,780	1,351	
Dry and siliceous silver	2		200		
Copper	9	10	4	660	
Lead	2	18	46		298
	1,420	2,063	5,691	2,680	1,405

REVIEW OF COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, and lead in Oregon in 1938, by counties and districts, in terms of recovered metals

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				
Baker County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Baker		5			541	541	76			$18,984
Bull Run	2		138	66		66	22	716		2,394
Connor Creek		1			105	105	16			3,685
Cornucopia	4	4	43,723	18,688	165	18,853	74,039	68,731	16,914	715,232
Cracker Creek	1		87	117		117	23			4,110
Eagle Creek		(4)			4	4				140
Hereford		6			575	575	109			20,195
Homestead		(4)			3	3	2			106
Mormon Basin [5]	3	6	137	54	310	364	73			12,787
Rock Creek	3	(4)	1,730	1,034	17	1,051	9,247	4,553	24,976	44,358
Sparta	2	2	1,767	1,334	19	1,353	214			47,493
Sumpter		4			12,423	12,423	2,917			436,691
Virtue	4	(4)	3,643	995	8	1,003	179		110	35,226
Weatherby	4	(4)	114	190	111	301	77			10,585
Coos County:										
Coos Bay		(4)			2	2	1			71
Johnson Creek		3			87	87	14			3,054
Randolph		1			18	18	2			631
Curry County:										
Agness		(4)			4	4				140
Chetco	1		150	98		98	5			3,433
China Diggings	1		2	3		3	1			106
Gold Beach		1			24	24	1			841
Mule Creek		1			3	3				105
Port Orford		2			43	43	3			1,507
Sixes		2			11	11	4			387
Douglas County:										
Cow Creek		3			173	173	17			6,066
Green Mountain	2	(4)	26	36	31	67	9			2,351
Myrtle Creek		3			63	63	9			2,211
Riddle		(4)			8	8	2			281

See footnotes at end of table.

Mine production of gold, silver, copper, and lead in Oregon in 1938, 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	Total value
	Lode	Placer		Lode	Placer	Total				
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	
Grant County:										
Black Butte	1		20	3		3	1			$106
Canyon	3	10	432	98	15,829	15,927	1,708			558,549
Desolation		2			23	23	4			808
Granite	5	3	1,924	780	2,122	2,902	3,943	649	1,773	104,264
Greenhorn [6]	7	5	467	176	848	1,024	3,672	1,351	227	38,357
North Fork John Day		4			15	15	3			527
Quartzburg	2	2	81	70	604	674	120			23,668
Susanville	1	(7)	2	19	(7)	[8] 19	[8] 3			[8] 667
Harney County:										
Idol City		1			10	10	2			351
Pueblo Mountain	1		9	2		2				70
Jackson County:										
Ashland	1	1	1,815	663	50	713	250			25,117
Gold Hill	8	7	155	74	351	425	81			14,927
Greenback [9]	1	(4)	20	4	30	34	5			1,193
Jacksonville	4	2	183	116	221	337	213			11,933
Upper Applegate	5	15	11	12	5,782	5,794	877			203,357
Josephine County:										
Althouse		(4)			43	43	6			1,509
Galice	(7)	11	(7)	(7)	591	[10] 591	[10] 64			[10] 20,726
Grants Pass	1	2	343	83	564	647	86			22,701
Greenback [9]	2	13	8,750	353	6,687	7,040	1,071			247,092
Illinois River	2	8	16	12	383	395	47			13,855
Lower Applegate	3	3	238	370	178	548	147			19,275
Waldo	1	12	12	2	1,925	1,927	211			67,581
Lane County: Bohemia	3		315	15		15	9			531
Malheur County:										
Malheur		1			19	19	3			667
Mormon Basin [5]		2			114	114	22			4,004
Snake River		(4)			13	13	2			456

Marion County: North Santiam	1	(4)	6	1	2	3	1	----------	----------	106
Morrow County: Columbia River	----------	1	----------	----------	1	1	----------	----------	----------	35
Union County: Camp Carson	----------	1	----------	----------	11	11	----------	----------	----------	385
Wheeler County: Spanish Gulch	----------	1	----------	----------	29	29	5	----------	----------	1,018
Combined districts [11]	5	6	8,620	1,930	3,138	5,068	889	----------	2,000	178,048
Total Oregon	84	157	74,936	27,398	54,331	81,729	100,507	76,000	46,000	2,935,053

[1] Only those districts shown separately for which Bureau of Mines is at liberty to publish figures; other producing districts listed in footnote 11 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: 92,206 ounces from lode mines and 8,301 ounces from placers.
[4] Not reported.
[5] Mormon Basin district lies in both Baker and Malheur Counties.
[6] Greenhorn district lies in both Baker and Grant Counties.
[7] Included under "Combined districts."
[8] Exclusive of placer output, which is included under "Combined districts."
[9] Greenback district lies in both Jackson and Josephine Counties.
[10] Exclusive of lode output, which is included under "Combined districts."
[11] Includes following districts: Greenhorn (placer) in Baker County; Rock Creek (placer) in Coos County; Canyonville (placer) and Mount Reuben (placer) in Douglas County; Susanville (placer) in Grant County; Elk Creek (lode) in Jackson County; Galice (lode) in Josephine County; and Gold Butte (lode) in Marion County.

BAKER COUNTY

Baker district.—The dragline dredge working on the Elk Creek Placers was the principal producer in the Baker district in 1938; litigation closed operations in September.

Cornucopia district.—The Cornucopia mine, operated by Cornucopia Gold Mines, treated 42,310 tons of gold ore and 1,348 tons of old tailings by flotation during 1938 and became the largest gold producer in Oregon after a record of several years as the largest producing lode mine. The metals recovered from 1,590 tons of concentrates and 8 tons of crude ore shipped to a smelter were: Gold, 18,604 fine ounces; silver, 73,824 fine ounces; copper, 68,071 pounds; and lead, 16,494 pounds.

Hereford district.—L. B. Jackson and W. B. Pattison operated during the last 8 months of 1938 a nonfloating washing plant, fed by power shovel, on their property 6 miles east of Hereford.

Rock Creek district.—Operations at the Highland Maxwell mine were terminated during 1938.

Sparta district.—The Maiden Creek mine, formerly known as the Macy, produced 1,764 tons of gold ore yielding 1,331 ounces of gold and 207 ounces of silver in 1938; it was the largest producer in the Sparta district.

Sumpter district.—The Sumpter Valley Dredging Co. operated a connected-bucket dredge, equipped with seventy-two 9-cubic-foot buckets, at its Sumpter Valley Placers throughout 1938 and was the largest producer of placer gold in the State. Consuelo Oregon Mines started production with a dragline dredge in May 1938. H. F. England & Co. operated a dragline dredge in the Sumpter district for 30 days but owing to unsatisfactory recoveries moved to a property near Prairie City in the Quartzburg district, Grant County. Little, Harris, and Wolfinger mined 100,000 cubic yards of gravel with a dragline dredge equipped with a 1½-cubic-yard bucket and produced 714 ounces of gold between October 8 and the end of 1938.

Virtue district.—The Hidden Treasure mine was the only large producer in the Virtue district in 1938; 351 tons of ore shipped for smelting yielded 641 ounces of gold and 130 ounces of silver.

COOS COUNTY

Johnson Creek district.—Several small-scale placer operations in 1938 were reported along Johnson Creek.

CURRY COUNTY

Port Orford district.—Dorothy Faris and Associates, the largest producer in Curry County in 1938, suspended operations at the Cape Blanco placer when its lease expired March 29.

DOUGLAS COUNTY

Cow Creek district.—Several small placer operations in 1938 were reported along Cow Creek, particularly at Yokum Bar.

GRANT COUNTY

Canyon district.—Ferris & Marchbank treated 1,512,595 cubic yards of gravel and recovered 7,707 ounces of gold with a Diesel-powered dragline dredge operating on John Day River west of John Day; the equipment consisted also of a Diesel-electric floating washer. The Western Dredging Co. operated a connected-bucket dredge, equipped with seventy-two 6-cubic-foot buckets, throughout 1938. The Miller Mountain mine was the most-productive lode property in the Canyon district.

Granite district.—Porter & Co. began operations September 10, 1938, in the Granite district with a connected-bucket dredge, equipped with sixty-two 4½-cubic-foot buckets; the property, owned by the Blue Mountain Gold Dredging Co., is near Granite and adjoins Granite, Olive, Clear, Crane, and Bull Run Creeks. Independence Cougar Mines, which operated the Independence and Cougar groups, shipped 621 tons of ore from which 501 ounces of gold were recovered. At the New York mine 1,030 tons of ore were treated by cyanidation, with a recovery of 204 ounces of gold.

Greenhorn district.—The Western Gold Corporation began dragline dredge operations September 8, 1938, on Granite Creek and was the largest producer of gold in the Greenhorn district in 1938. Ore from the Intermountain mine was shipped for smelting.

Quartzburg district.—H. F. England & Co. moved its dragline dredge from the Sumpter district in Baker County to the Quartzburg district and began operations October 18, 1938, on Dixie Creek 1 mile from Prairie City; the treatment of 90,000 cubic yards of gravel yielded 513 ounces of gold. Ore from the Yankee Boy group north of Prairie City was treated by amalgamation.

Susanville district.—The Timms Gold Dredging Co. operated its connected-bucket dredge, equipped with sixty-four 3½-cubic-foot buckets, throughout 1938 on the Middle Fork of John Day River; it was the chief producer in the Susanville district.

JACKSON COUNTY

Ashland district.—P. B. Wickham continued development at the Ashland mine during 1938 and obtained considerable gold ore that was treated by amalgamation.

Gold Hill district.—A lessee worked the Lance Bros. property on Foots Creek with a nonfloating washing plant from the first of 1938 until April 20; 25,700 cubic yards of material were treated to recover 241 ounces of gold. The Black Channel mine, also on Foots Creek, was operated by hydraulicking during the first 4 months of the year. Several other mines, both lode and placer, reported small outputs.

Upper Applegate district.—The B-H Co. worked its placer property on Forest Creek by dragline dredging throughout most of 1938. Christean & Dobbyn worked a drift mine on Forest Creek which yielded more gold than any other drift operation in the State. The Glide Foundation operated a dragline dredge on Poorman's Creek part time over a period of 4 months in 1938. Sterling Mines, Inc., worked its hydraulic mine on Sterling Creek and was the second-largest producer of gold recovered by hydraulicking in the State.

JOSEPHINE COUNTY

Galice district.—A large number of small operators were reported active at placer mines in the Galice district during 1938. Small-scale hand methods yielded considerable gold at the Old Channel property. The Lewis Investment Co. worked the Benton mine almost continuously in 1938 and shipped its cyanide precipitates to a smelter; this property, which started operations August 28, 1937, was the second-largest producer of lode gold in Oregon in 1938. A small output of gold ore was reported from the J. C. L. mine during 6 months of operation.

Grants Pass district.—Surety Placers, Inc., worked a substantial yardage by hydraulicking at its property on Louse Creek during the early months of 1938; later in the year a lessee started operations. The Lambtongue mine north of Grants Pass produced 343 tons of gold ore, from which 83 ounces of gold were recovered by amalgamation and smelting of concentrates.

Greenback district.—The principal producer in the Greenback district—the Rogue River Gold Co.—discontinued operation of its connected-bucket dredge November 30, 1938, after several years of production; the dredge was of the company's own design and construction and was equipped with sixty-five 7½-cubic-foot buckets. The company had perfected a method of water clarification to meet the demands of recreational interests on the lower Rogue River. Gravel was mined at the Blue Channel property on Coyote Creek by hydraulicking in 1938. The Columbia mine was one of the larger producers of gold by hydraulicking in the district and in the State. Hydraulicking at the 3 L's mine on Grave Creek resulted in the recovery of 71 ounces of gold from 11,000 cubic yards of gravel. The recovery of 339 ounces of gold and 321 ounces of silver was reported from the cyanidation of 8,600 tons of old tailings at the Greenback mine. During the year P. B. Wickham, of the Ashland mine in Jackson County, leased this property for a period of 10 years; he had no part in production at the mine in 1938 but did some repair work.

Illinois River district.—Small placer and lode operations were reported in the Illinois River district in 1938.

Lower Applegate district.—The Oregon Bonanza lode mine was operated throughout 1938; treatment of 187 tons of ore, partly by amalgamation and partly by direct smelting, resulted in the recovery of 349 ounces of gold and 114 ounces of silver.

Waldo district.—The recovery of 517 ounces of gold from 100,000 cubic yards of gravel by hydraulicking in 1938 was reported at the Esterly (Llano de Oro) mine; this property was the largest producer of gold recovered by hydraulicking in the State. Several operators worked the Leonard mine on Althouse Creek; virtually all the gold was recovered at a stationary washing plant, to which the gravel was delivered by trucks loaded by power shovels. The Platurica (Plataurica) mine in the O'Brien section of the Waldo district yielded 119 ounces of gold from the hydraulicking of 80,000 cubic yards of gravel during the first 3 months of 1938.

OTHER COUNTIES

Small outputs in 1938 were reported also from Harney, Lane, Malheur, Marion, Morrow, Union, and Wheeler Counties.

Details of production by counties and districts are given in the preceding table.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Gold production in South Dakota set a new annual record in 1938, totaling 594,847 fine ounces valued at $20,819,645. The increase over 1937 was 13,303 ounces and over 1936, the former record year, 8,494 ounces. As usual, the Homestake mine at Lead, Lawrence County, the largest producer of gold in the United States, yielded the bulk of the gold; three other important producers in Lawrence County and one in Pennington County increased their output. Placer mines, mostly on French Creek, produced all the gold shipped from Custer County in 1938. From 1875 through 1938 these three counties, situated in the Black Hills area in the southwestern part of the State, have produced all the State output of gold, silver, copper, and lead. The silver recovered in South Dakota in 1938 was a byproduct of gold mining. No recoverable copper has been produced in the State since 1918 and no lead since 1935.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price: 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Except for a slight drop in 1937 from 1936, gold production in South Dakota has increased annually over the 5-year period ended with 1938. The quantity of silver recovered varied somewhat in proportion to the gold produced in the individual years but also increased for the period. The only silver recovered other than as a byproduct of gold mining during the 5 years was 1,519 ounces contained in 30 tons of lead-silver ore shipped to a smelter in 1935.

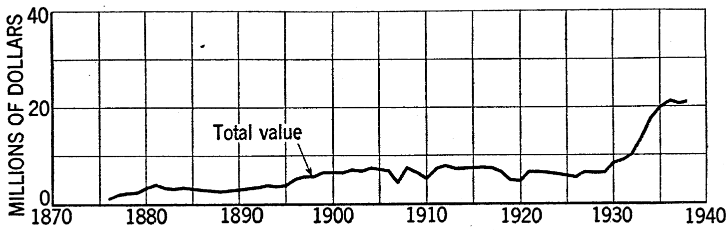

FIGURE 1.—Total value of mine production of gold and silver in South Dakota, 1876-1938.

Mine production of gold, silver, copper, and lead in South Dakota, 1934-38, and total, 1875-1938, 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
1934	8	258	1, 520, 669	486, 118. 97	$16, 989, 858	99, 741	$64, 479
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
1875-1938			(2)	18, 232, 108. 00	419, 720, 989	8, 832, 407	6, 288, 627

Year	Copper		Lead		Total value
	Pounds	Value	Pounds	Value	
1934					$17, 054, 337
1935			7, 000	$280	19, 961, 902
1936					20, 634, 244
1937					20, 462, 050
1938					20, 924, 563
1875-1938	195, 691	$34, 598	575, 313	34, 820	426, 079, 034

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, 1934-38, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1934	1, 080. 20	$37, 753	85	$55	$37, 808
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

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in South Dakota in 1938, 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		15	888.20	$31,087	73	$47	$31,134
Lawrence	6	3	590,686.60	20,674,031	161,593	104,464	20,778,495
Pennington	5	53	3,272.20	114,527	629	407	114,934
	11	71	594,847.00	20,819,645	162,295	104,918	20,924,563

Gold and silver produced at placer mines in South Dakota in 1938, 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	52.80	6			835.40	67	888.20	73
Lawrence	42.00	2					42.00	2
Pennington	82.18	5	22.47	1	34.15	1	138.80	7
	176.98	13	22.47	1	869.55	68	1,069.00	82
Total, 1937	107.44	6			903.16	69	1,010.60	75

[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 was 1,586,181 tons yielding 593,778 fine ounces of gold and 162,213 fine ounces of silver in 1938 compared with 1,597,178 tons yielding 580,533 ounces of gold and 139,563 ounces of silver in 1937. The average yield in metals per ton of ore therefore increased slightly in 1938. An analysis of methods of treatment shows that 1,417,222 tons were treated by amalgamation followed by cyanidation of sands and slimes; 155,667 tons by cyanidation only or by roasting followed by cyanidation; 1,169 tons by amalgamation only; 12,000 tons by amalgamation and flotation concentration (237 tons of concentrates containing 729.20 ounces of gold and 170 ounces of silver were shipped to smelters); and 123 tons containing 2,091.09 ounces of gold and 664 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, 1934–38

Year	Ore treated	Gold in bullion	Silver in bullion	Quicksilver used
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*
1934	1,441,052	310,941.73	58,086	9,663
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	62,602	7,744

Gold and silver bullion produced at mills in South Dakota by cyanidation, 1934–38

Year	Material treated: Crude ore	Material treated: Sands and slimes	Material treated: Total	Gold in bullion product	Silver in bullion product	Sodium cyanide used [1]
	Short tons	*Short tons*	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*
1934	79,617	1,432,045	1,511,662	174,097.04	41,570	519,724
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	[2] 860,762

[1] In terms of 96- to 98-percent strength.
[2] Actually 1,589,300 pounds of calcium cyanide (48- to 49-percent strength) and 69,745 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 dragline and screening and sluicing plant on French Creek, 1 mile west of Custer, from April 13 to November 15, 1938. The Anchor Gold Mining Co. ran a gasoline shovel and washing plant for 30 days on the McKenna property on French Creek. A dragline and sluice were operated from October 1 to November 1 at the Rhodes property on French Creek, 1 mile east of Custer, and recovered 15.18 fine ounces of gold. Small-scale sluicing and panning along French Creek recovered some gold in 1938. No production was made from lode mines in Custer County during the year.

LAWRENCE COUNTY

Homestake mine.—The annual report of the general manager of the Homestake Mining Co. for the year ended December 31, 1938, says—

Operations during 1938 were normal in all departments. Ore production from the mine was a little lower than in 1937 and the gross income for gold and silver produced was one-tenth of 1 percent less. Production for 1939 will probably approximate that of 1938.

Operating expenses exclusive of taxes were substantially the same as in 1937. Taxes again increased to a total of $3,052,795.67, or $2.22 per ton of ore mined. The increased tax burden has eliminated a substantial tonnage of marginal ore from the reserve.

There are 189,571 tons of broken ore remaining in shrinkage stopes.

The reserve of developed ore is 18,558,019 tons. Of this reserve 6,446,350 tons are in the new ledge referred to in the report for 1937. The ore developed in this ledge is materially lower in grade than that in the main ledges.

The mine, treatment plants, and other surface plants are in excellent condition. Reconstruction and modernization of Cyanide sand plant No. 1 was completed except for minor alterations of pipes and launders. There was no interruption of operation during construction.

A new operating shaft was authorized in May. It was named the Yates Shaft in memory of Mr. B. C. Yates. This shaft will replace the Ellison Shaft which has for some years been protected by leaving ore pillars. The new shaft will be equipped for an ultimate depth of 5,000 feet. 12,850 feet of connecting drifts for this shaft and 1,576.5 feet of pilot raises in the shaft are completed.

The Ross Shaft is completed to the 4,100-foot level with a 60-foot sump below that level.

The winze from the 4,100-foot level was completed to the 4,400-foot level and 957 feet of level development completed on the 4,400-foot level.

Power output from the hydroelectric plants was slightly less than in 1937. Ample power was supplied from the Kirk power station.

Ore milled, receipts, and dividends, Homestake mine, 1934–38 [1]

Year	Ore milled (short tons)	Receipts for bullion product		Dividends
		Total	Per ton	
1934	1,440,692	$16,515,684.14	$11.4637	$7,534,800
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

[1] From 1876 to 1938, inclusive, this mine yielded bullion and concentrates that brought a net return of $360,075,014 and paid $115,145,722 in dividends.

The system of mining used at the Homestake mine has been described briefly as follows:[1]

The ore body is first cut by a series of stopes each extending for 60 feet along the strike and from wall to wall of the deposit—a distance which may be as great as 400 feet. Pillars of ore 42 feet in thickness separate the 60-foot stopes. A stope is started by making a cut entirely across its bottom. A timbered gangway provided with chute gates is next constructed across the floor of the cut and waste filling is introduced around it. The stope is then carried upward by shrinkage stoping to within about 25 feet of the level above. The interval between levels is 100 feet in the upper part of the mine and 150 feet in the lower. During shrinkage stoping, the miners stand upon the broken ore, enough being drawn off regularly through the chute gates into the gangway to keep the ore away from the back and provide room for the miners to work. When shrinkage stoping is completed, the broken ore remaining in the stope is all drawn off, and the stope is filled with waste rock or mill tailings. The crowns of the stopes and the pillars between them are later mined by the square-set timbering system, the square sets being filled with waste.

The ore drops from the chutes into ore cars pulled by compressed-air locomotives and is taken to the shafts for hoisting. Primary crushing of the ore is done at the shafts. From the shafts the ore is moved by a rail tramway to the South mill, which has a capacity of 3,900 tons per 24 hours. Here the ore is reduced further by stamps and fed to rod mills in closed circuit with Clark-Todd amalgamators for primary grinding and to ball mills and pebble mills in closed circuit with Clark-Todd amalgamators for secondary grinding. The copper amalgamation plates, for many years an integral part of the mill equipment, gradually are being replaced by the Clark-Todd amalgamators. Classification is done partly in the South mill and is finished in cyanide sand plant No. 1 and cyanide sand plant No. 3. In plant No. 3 part of the sand tailings from the South mill are classified and ground further in ball mills in closed circuit with Clark-Todd amalgamators. The sands are treated by cyanide leaching, and the slimes are thickened and sent to the slime plant at Deadwood for further treatment. In plant No. 1 a partly classified sand portion of the tailings from the South mill is separated by cone classification into sand and slime fractions. In this plant the sands are leached, and the solutions from both this plant and plant No. 3 are precipitated. Slimes are piped to the slime plant at Deadwood, which accomplishes cyanidation of the slimes from both plants. Precipitation is by the Merrill-Crowe process. Silver is parted from the gold in the company refinery, and virtually pure metals are shipped to the mint.

[1] Lincoln, Francis Church, Miser, Walter G., and Cummings, Joseph B., The Mining Industry of South Dakota: South Dakota Sch. Mines Bull. 17, February 1937, pp. 12–14.

Other mines.—The Bald Mountain Mining Co. maintained production from its consolidated group of mines and 325-ton cyanide mill at Trojan continuously at capacity in 1938. The yield in recovered metals from 118,026 tons of ore treated in the mill and 123 tons of high-grade ore shipped to smelters was 23,899 fine ounces of gold and 34,012 fine ounces of silver, which together brought a net return of $851,245.33 after deductions for transportation and mint and smelter charges. The company paid $231,250 in dividends in 1938. Additions to the plant included intermediate grinding and accessory equipment for all ores and a 100-ton rotary hearth roasting furnace for sulfide ores. The ore treated in 1938 came from the Portland, Trojan, Foley, Dakota, and Clinton claims and was brought to the mill by rail tramway and trucks. The company did 13,260 feet of development work in the mine during the year.

Gold production of the Canyon Corporation from the refractory sulfide ores (commonly known as blue ores) of the Maitland group 5½ miles northwest of Deadwood increased in 1938 over 1937. Besides gold and silver, the ores contain pyrite, silica, dolomite, and some undetermined arsenic mineral. Treatment is by the roast-cyanidation process. The mill handled a daily average of 103 tons for 365 days in 1938. Mine development work done totaled 4,850 feet. The mine is opened by a 350-foot shaft and drifts and winzes.

Gilt Edge Mines, Inc., which began production from the Gilt Edge-Dakota Maid group in May 1937, continued operations throughout 1938 at an average rate in excess of 100 tons of ore daily. The mine is opened by a 150-foot vertical shaft and 3,100 feet of useful tunnels and drifts, of which 1,200 feet were driven in 1938. Most of the ore extracted was oxidized, and all was treated by the all-slime cyanide process in the company mill. During the year a jig and amalgam barrel were installed to recover free gold from the ball-mill circuit.

Gold, Inc., continued to do development work at the Minnesota group 4 miles northeast of Rochford on Gimlet Creek and treated ore intermittently in the mill at the mine. The equipment of the mill consists of 10 stamps, jaw crusher, rolls, ball mill, amalgamator, classifier, flotation machine, and table. Small lots of gold recovered by amalgamation were shipped to the Denver Mint. About 30 tons of concentrates produced were stored at the mill. Ore from the Belle Eldridge property was shipped to the Canyon Corporation mill early in 1938.

PENNINGTON COUNTY

Empire Gold Mines, Inc., operated its Golden Slipper mine 5 miles east of Hill City continuously in 1938. The output was 12,000 tons of ore, which was treated in the company mill by ball-mill grinding, jig concentration, and plate amalgamation, followed by flotation of the tailings from the plates. The jig concentrates were amalgamated in a barrel. Gold valued at $82,388 was recovered by amalgamation and shipped to the Denver Mint during the year. The concentrates, containing gold valued at smelter payment at $23,770, were sold to the East Helena (Mont.) and Leadville (Colo.) smelters. The silver contained in both bullion and concentrates was valued at $350. The ore is hoisted through an incline shaft 550 feet deep. Development work done in the mine during the year totaled 3,500 feet. During December 1938 and January 1939 a cyanide unit was installed to treat the flotation concentrates. The other four lode mines and prospects producing in Pennington County in 1938, all operated on a small scale, comprised the Burlington, from which a little gold was recovered by hand methods; Gold Lode, equipped with a 20-ton amalgamation mill; Murphy-Nelson property, equipped with a small jig and table; and Shellerud, equipped with a small stamp-amalgamation mill.

The Anchor Gold Mining Co., working placer ground on Gold Run and Cement Creeks in the summer of 1938 with a 1½-yard dragline excavator and a portable land dredge, handled 5,000 cubic yards of gravel from which were recovered 35.03 crude ounces of placer gold 0.975 fine. Owing to a shortage of water the equipment could not be run continuously, and the total operating time was only about 10 days. Individuals sluicing, drift mining, and panning on Battle, Castle, Rapid, Spring, and Slate 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.

159434—39——30

GOLD, SILVER, COPPER, LEAD, AND ZINC IN TEXAS

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

Virtually all the gold and lead and most of the copper produced in Texas in 1938 came from mines producing silver as the metal of chief value. Compared with 1937, the output of silver in 1938 increased 8 percent in quantity but decreased 10 percent in value owing to a drop of nearly 17 percent in the Government-fixed price of silver. The quantity and value of the other three metals, especially copper, decreased in 1938; however, their combined value was only $105,000 in 1937 and $49,965 in 1938 compared with $1,025,398 and $926,389, respectively, for silver alone. The Presidio mine of the American Metal Co. at Shafter, Presidio County, was the only large producer in the State in 1938. The output of the Plata Verde mine near Van Horn in Hudspeth County, a substantial producer of silver in 1936 and 1937, declined heavily in 1938.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
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1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

MINE PRODUCTION

The following table shows the annual output of ore and the quantity and value of the metals recovered from Texas mines from 1934 to 1938, as well as the total metal production from 1885 to 1938.

Mine production of gold, silver, copper, lead, and zinc in Texas, 1934–38, and total, 1885–1938, in terms of recovered metals

Year	Ore (short tons)	Gold		Silver	
		Fine ounces	Value	Fine ounces	Value
1934	47,680	358.74	$12,538	854,442	$552,367
1935	72,222	518.00	18,130	1,000,960	719.440
1936	104,990	613.00	21,455	1,361,459	1,054,450
1937	120,145	562.00	19,670	1,325,660	1,025,398
1938	131,002	439.00	15,365	1,433,008	926,389
1885–1938	(1)	7,099.00	182,410	28,749,634	20,240,960

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	29,000	$2,320	719,000	$26,603			$593,828
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
1885–1938	[2] 886	262,885	[2] 3,976	400,203	[2] 744	$106,491	21,192,949

[1] Figures not available.
[2] Short tons.

Mine production of gold, silver, copper, and lead in Texas in 1938, by counties, in terms of recovered metals

County	Mines producing	Ore (short tons)	Gold (fine ounces)	Silver (fine ounces)	Copper (pounds)	Lead (pounds)
Culberson	2	378		8,214	7,000	
Hudspeth	4	3,050	0.53	45,607	25,000	3,000
Presidio	1	127,574	438.47	1,379,187		681,000
	7	131,002	439.00	1,433,008	32,000	684,000
Total, 1937	7	120,145	562.00	1,325,660	320,000	790,000

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 1938, with content in terms of recovered metals

Source	Mines producing	Ore	Gold	Silver	Copper	Lead
		Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Dry and siliceous silver ore	3	130,923	438.47	1,431,696	25,674	682,560
Copper ore	3	70		1,235	6,326	
Lead ore	2	9	.53	77		1,440
	[1] 7	131,002	439.00	1,433,008	32,000	684,000
Total, 1937	7	120,145	562.00	1,325,660	320,000	790,000

[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

Although silver is the only one of the five metals reviewed in this chapter of which Texas is a large producer, the State derives much benefit through its smelting and refining industries from silver and other metals produced outside the State. Custom smelters of the American Smelting & Refining Co. in Texas furnished a market for ores and concentrates from eight Western States in 1938. The copper and lead plants at El Paso treated gold, silver, copper, and lead ores and concentrates from Arizona, California, Colorado, New Mexico, and Texas and lead ore in bond from Mexico. The natural-gas-retort zinc-smelting plant at Amarillo treated zinc concentrates from Arizona, Colorado, Idaho, Nevada, New Mexico, and Utah. The Illinois Zinc Co. horizontal-retort zinc smelter 5 miles northeast of Dumas was run on lead-free zinc concentrates from the Peru mill at Deming, N. Mex., and on other zinc concentrates received from operators in Washington and the Tri-State district of Oklahoma, Kansas, and Missouri.

The Nichols electrolytic copper refinery at El Paso continued in 1938 to treat copper anodes produced at the Arizona smelters of the Phelps Dodge Corporation. The plant is operated by the Nichols Copper Co., which since 1934 has been a unit of the Phelps Dodge Corporation. About 8,000 tons of anodes pass through the refinery monthly.

Natural gas is used for fuel by all the foregoing plants.

MINES-REVIEW BY COUNTIES

Culberson County.—Lessees working on the three upper levels of the Hazel mine, 16 miles northwest of Van Horn, from March 15 to December 31, 1938, shipped 373 tons of silver-copper ore to the El Paso smelter. The mine is developed by a vertical shaft 746 feet deep and about 5,000 feet of drifts, crosscuts, and raises. The drifts on each of the three upper levels are about 400 feet long. The lessees did 50 feet of sinking on a new shaft in 1938. A 5-ton lot of copper-silver ore was shipped from another property in Culberson County during the year.

Hudspeth County.—Siliceous silver ore containing some copper, shipped to the El Paso smelter from the Plata Verde mine 14 miles by road southwest of Van Horn, yielded most of the metal output of Hudspeth County in 1938. The mine was operated by the owners, Drunzer and Buchholtz, at a reduced tonnage rate after the lessees relinquished it on January 15. A lessee at the Black Shaft mine in the Allamoore district shipped 54 tons of copper-silver ore to the El Paso smelter early in the year. A small lot of lead-silver ore was shipped to the smelter from each of two properties near Sierra Blanca.

Presidio County.—The American Metal Co. of Texas operated its Presidio silver mine at Shafter continuously in 1938. The mine is developed by two vertical shafts, one 400 feet and one 700 feet deep; two underground subshafts, one 100 feet and one 200 feet deep; and eight levels with stopes, raises, and other openings totaling more than 50 miles of underground workings. Development work in 1938 totaled 9,036 feet, of which 6,747 feet were prospecting, and diamond drilling totaled 30,127 feet. The ore is found as a replacement of limestone beds and is oxidized, the principal mineral being silver chloride associated with argentite, cerargyrite, galena, anglesite, and cerussite. A rail tramway runs from the west shaft to the east shaft, which is connected by aerial tramway with the company 350-ton gravity concentration-cyanidation mill at Shafter, 1 mile away. The ore 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 it 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 1938 the mill produced 685 tons of table concentrates averaging 0.079 ounce of gold and 405.82 ounces of silver to the ton and 49.95 percent lead. 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] 1885–1938[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
Total, 1885–1938	1,808,406	16.96	30,669,190	84.57	25,936,603

[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 value of the metal production in Utah in 1938 was $43,745,902, or slightly less than half the value of the 1937 output. The pronounced recession was caused by lower average metal prices combined with curtailed output of copper ore at Bingham and zinc-lead ore at Park City. There were decreases in all five metals, especially copper which declined from a record output of 411,988,000 pounds in 1937 to 216,252,000 pounds in 1938; the total value of the copper dropped 57 percent.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935-38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935-37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Utah, 1934–38, and total, 1864–1938, 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
1934	190	28	5,076,735	136,581.52	$4,773,524	7,111,417	$4,597,280
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
1864–1938	----------	----------	(1)	8,068,483.00	182,621,945	646,973,710	472,693,109

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	86,024,925	$6,881,994	116,153,945	$4,297,696	56,396,279	$2,425,040	$22,975,534
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
1864–1938	[2] 2,975,934	888,361,189	[2] 3,944,883	425,850,932	[2] 669,293	80,427,285	2,049,954,460

[1] 1864–1901: Figures not available; 1902–38: 340,379,723 tons produced.
[2] Short tons.

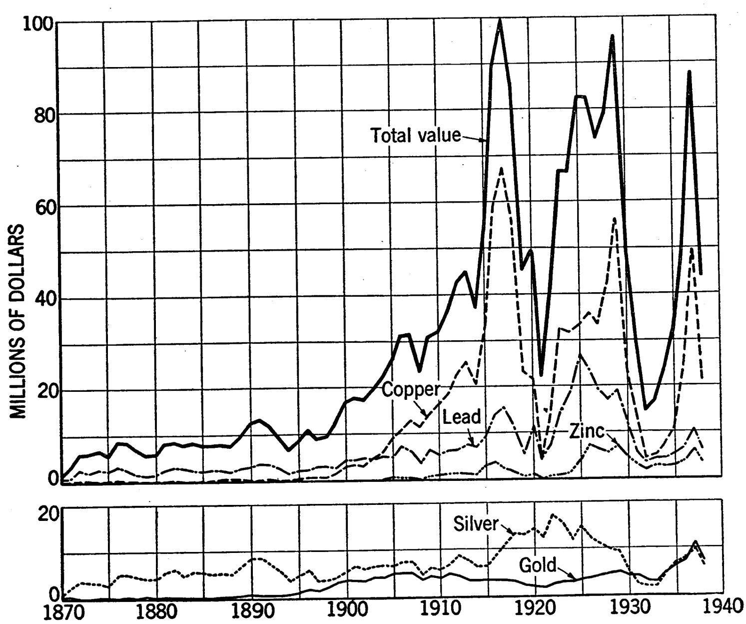

FIGURE 1.—Value of mine production of gold, silver, copper, lead, and zinc and total value in Utah, 1870–1938.

Gold.—The output of gold in Utah fell 122,129 ounces in 1938; gold from copper ore declined more than 104,000 ounces as a result of curtailment by the Utah Copper Co., and there were also decreases in gold from all other classes of ore. Copper ore yielded 49 percent of the total, siliceous ore 35 percent, and zinc-lead ore 13 percent; ore of all classes treated at concentration mills yielded 62 percent, crude ore smelted nearly 30 percent, and ore to amalgamation and cyanidation mills 8 percent. Mines in the West Mountain district produced 64 percent of the total gold, despite a decrease of 110,759 ounces in the district output. The Utah Copper Co. was, as usual, the largest gold producer in Utah, followed by the United States & Lark, Con Mercur, Mammoth, and Eureka Standard mines; these five mines yielded nearly 74 percent of the total gold.

Silver.—The output of silver in Utah in 1938 was 3,186,385 ounces less than in 1937. Production from the Bingham district decreased 1,201,685 ounces, chiefly as a result of curtailment by the Utah Copper Co.; and that from Park City declined 1,169,976 ounces, as increases at the Park City Consolidated and Park Galena properties were more than offset by large decreases caused by the closing of the Silver King Coalition and Park Utah Consolidated properties. The yield of silver from the Tintic district was 520,792 ounces less than in 1937, due to decreases at nearly all the large producers in the district. Zinc-lead ore yielded 47 percent of the total silver from Utah, siliceous ore nearly 32 percent, lead ore 12 percent, and copper ore 9 percent. Nearly 57 percent of the total came from ore milled and 43 percent from crude ore smelted. The United States & Lark mine at Bingham was again the largest silver producer in Utah, followed by the Tintic Standard, Park City Consolidated, Utah Copper, and Silver King Coalition properties; these five properties produced nearly 70 percent of the total silver.

Copper.—Suspension of operations by the Utah Copper Co. for 6 weeks during June and July 1938 and curtailment in the rate of operations for the rest of the year caused a decrease in output of copper ore by the company from 23,119,800 tons in 1937 to 11,704,900 tons in 1938. As a result, recoverable copper produced in Utah declined from 411,988,000 to 216,252,000 pounds. An increase in copper production was reported by the Ohio Copper Co. due to full-year operation of the mill completed late in 1937. Copper ore and mine-water precipitates yielded nearly 96 percent of the total copper, and most of the remainder came from zinc-lead ore milled and siliceous ore smelted.

Lead.—The output of recoverable lead in Utah fell from 178,916,000 pounds in 1937 to 131,314,000 pounds in 1938. Most of the decrease was in zinc-lead ore from Park City, due to the closing of the Silver King Coalition and Park Utah Consolidated properties, but there were also decreases in the Bingham, Tintic, Ophir, and Rush Valley districts. Zinc-lead ore yielded 72 percent of the total, lead ore 21 percent, and siliceous ore 6 percent; ore milled and smelted yielded 73 percent of total and ore smelted direct 27 percent. The United States & Lark mine at Bingham was, as usual, the largest producer of lead in Utah, followed by the Tintic Standard, Silver King Coalition, Boston Consolidated, and West Calumet properties; these five mines produced 74 percent of the State total.

Zinc.—The output of recoverable zinc in Utah decreased 28,686,000 pounds in 1938. Production from Park City declined more than 27,300,000 pounds and that from Tooele County also decreased, but output from the Bingham district increased slightly. Zinc ore and zinc-lead ore shipped crude to smelters yielded 96,079 pounds of recoverable zinc, and the remainder of the zinc came from complex zinc-lead-iron ore treated in four flotation plants. The United States & Lark, Silver King Coalition, West Calumet, Hidden Treasure, and Park City Consolidated mines were the leading zinc producers in Utah in 1938; these five mines produced 84 percent of the total zinc.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties, in terms of recovered metals

County	Mines producing		Ore	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer	Short tons	Fine ounces	Value	Fine ounces	Value
Beaver	16		5,509	739	$25,865	33,513	$21,665
Box Elder	8		182	33	1,155	3,182	2,057
Garfield		5		26	910		
Grand	1	5	3	23	805	68	44
Iron	8		1,255	562	19,670	4,902	3,169
Juab	22		155,492	19,521	683,235	958,436	619,595
Millard	3	1	66	12	420	48	31
Piute	12		9,359	1,497	52,395	19,933	12,886
Salt Lake	23		12,510,929	129,670	4,538,450	3,710,916	2,398,976
San Juan	2	2	149	19	665	181	117
Sevier	1		21	31	1,085	1,717	1,110
Summit	8		46,683	1,107	38,745	536,843	347,050
Tooele	55		275,995	25,584	895,440	405,982	262,453
Uintah	3	9	11	76	2,660	20	13
Utah	16		140,429	17,159	600,565	2,581,227	1,668,672
Wasatch	4		102,430	4,571	159,985	1,425,733	921,686
Washington	1		147			31	20
	183	22	13,248,660	[1] 200,630	7,022,050	9,682,732	6,259,544
Total, 1937	189	14	24,578,275	[2] 322,759	11,296,565	12,869,117	9,954,262

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Beaver	17,755	$1,740	392,500	$18,055	21,604	$1,037	$68,362
Box Elder	102	10	15,913	732			3,954
Garfield							910
Grand	398	39					888
Iron							22,839
Juab	1,239,500	121,471	4,596,848	211,455	730,521	35,065	1,670,821
Millard	1,184	116	2,413	111			678
Piute	5,714	560	23,978	1,103			66,944
Salt Lake	212,188,449	20,794,468	83,248,587	3,829,435	46,257,479	2,220,359	33,781,688
San Juan	12,255	1,201					1,983
Sevier							2,195
Summit	180,643	17,703	7,707,174	354,530	5,255,063	252,243	1,010,271
Tooele	1,032,102	101,146	13,539,370	622,811	7,752,583	372,124	2,253,974
Uintah	1,235	121	1,261	58			2,852
Utah	1,152,214	112,917	14,977,478	688,964	1,196,958	57,454	3,128,572
Wasatch	349,398	34,241	6,808,478	313,190	6,101,792	292,886	1,721,988
Washington	71,051	6,963					6,983
	216,252,000	21,192,696	131,314,000	6,040,444	67,316,000	3,231,168	43,745,902
Total, 1937	411,988,000	49,850,548	178,916,000	10,556,044	96,002,000	6,240,130	87,897,54[illegible]

[1] Includes 148 ounces of placer gold distributed as follows: Garfield County, 26 ounces; Grand County, 23 ounces; Millard County, 5 ounces; San Juan County, 18 ounces; and Uintah County, 76 ounces.
[2] Includes 55 ounces of placer gold.

MINING INDUSTRY

Curtailment by the Utah Copper Co. at Bingham and closing of the Silver King Coalition and Park Utah Consolidated properties at Park City resulted in marked decreases in the output of copper, lead, and zinc in Utah in 1938; the output of gold and silver also decreased as the larger part of the gold and silver from Utah comes from copper ore and zinc-lead ore. Most of the decrease was in the Bingham and Park City areas, but output in the Tintic, Ophir, and Rush Valley districts also decreased. There was an important increase in output of gold ore at Mercur.

Work of driving the Elton tunnel from Tooele to the Apex-Delaware group in the Bingham district was continued during 1938 by National Tunnel & Mines Co.; the adit was about one-fourth completed at the end of the year. The Bingham-Copperfield vehicular tunnel was completed by the Utah Copper Co. and placed in operation early in 1939. Other mine development and plant improvements of importance included the Thaynes shaft work by the Silver King Coalition Mines Co., enlargement of the Geyser Marion cyanide mill at Mercur, and erection of a 600-ton flotation plant at the Ophir Hill tailings dump.

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 1938, 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	50	283,472	41,381	326,711	708,936	1,019,338	
Dry and siliceous gold-silver ore	20	184,346	24,620	1,050,385	2,682,675	3,049,967	
Dry and siliceous silver ore	29	92,543	4,265	1,698,153	861,575	4,409,627	
	99	560,361	70,266	3,075,249	4,253,186	8,478,932	
Copper ore	14	12,032,385	98,100	919,224	[1] 207,014,357	6,285	
Lead ore	79	94,883	5,314	1,112,585	735,328	27,697,916	
Zinc ore	1	83				3,160	40,979
Zinc-lead ore	31	560,948	26,802	4,575,668	4,249,129	95,127,707	67,275,021
Total, lode mines	[2] 183	13,248,660	200,482	9,682,726	[1] 216,252,000	131,314,000	67,316,000
Total, placers	22		148	6			
	205	13,248,660	200,630	9,682,732	[1] 216,252,000	131,314,000	67,316,000
Total, 1937	203	24,578,275	322,759	12,869,117	[3] 411,988,000	178,916,000	96,002,000

[1] Includes 10,220,878 pounds recovered from precipitates.
[2] A mine producing more than 1 class of ore is counted but once in arriving at total for all classes.
[3] Includes 4,839,088 pounds recovered from precipitates.

METALLURGIC INDUSTRY

The 13,248,660 tons of ore produced in Utah in 1938 comprised 197,936 tons of ore treated at amalgamation and cyanidation mills (an increase from 127,288 tons in 1937), 12,597,042 tons treated at concentration plants (a marked decrease from 23,941,803 tons in 1937), and 453,682 tons shipped crude to smelters (compared with 509,184 tons in 1937).

Four gold and silver mills were operated in Utah in 1938. One small straight amalgamation mill in Box Elder County and one combined amalgamation and concentration plant in Piute County treated 7,624 tons of ore. Two cyanidation mills at Mercur, Tooele County—one of them also equipped for flotation concentration—treated 190,312 tons of ore; the ore treated at these cyanidation plants contained (gross assay) 21,464 ounces of gold and 1,110 ounces of silver, indicating recoveries (in bullion and concentrates) of nearly 74 percent of the gold and 61 percent of the silver. The plants used 87,266 pounds of sodium cyanide (91-percent grade), 38,106 pounds of zinc dust, and 646,330 pounds of lime.

Eight concentration plants (all straight flotation) were operated in Utah in 1938. Three plants (Magna, Arthur, and Ohio Copper) treated 12,031,615 tons of copper ore and old tailings, one (Ophir) treated 4,596 tons of lead tailings, and four (Bauer, Midvale, Tooele, and Silver King) treated 560,831 tons of zinc-lead ore.

The following tables give details of treatment for all the ore produced in Utah in 1938.

Mine production of metals in Utah in 1938, by methods of recovery, in terms of recovered metals

Method of recovery	Meterial treated	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Ore amalgamated	7,624	381	250			
Ore cyanided	190,312	14,391	634			
Concentrates smelted [1]	546,903	126,526	5,504,390	200,941,529	95,229,226	67,219,921
Ore smelted	453,682	59,184	4,177,452	5,089,593	36,084,774	96,079
Mine-water precipitates smelted [2]	6,607			10,220,878		
Placer		148	6			
		200,630	9,682,732	216,252,000	131,314,000	67,316,000
Total, 1937		322,759	12,869,117	411,988,000	178,916,000	96,002,000

[1] Includes zinc concentrates treated at electrolytic plants.
[2] All from Salt Lake County.

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Utah in 1938, 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
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*
Box Elder	50	23	8			
Piute	7,574	358	242	16	259	2,106
	7,624	381	250	16	259	2. 10
Total, 1937	20,538	2,186	2,646	47	641	5,599

CYANIDATION MILLS

County	Ore treated	Gold	Silver	Concentrates produced	Gold	Silver
Tooele	190,312	14,391	634	904	1,385	38
	190,312	14,391	634	904	1,385	38
Total, 1937	106,750	9,319	1,477	524	1,136	130
Grand total: 1938	197,936	14,772	884	920	1,644	2,144
1937	127,288	11,505	4,123	571	1,777	5,729

Mine production of metals from concentrating mills in Utah in 1938, by counties, in terms of recovered metals

County	Ore milled	Concentrates (to smelters and electrolytic plants) and recovered metal					
		Concentrates produced	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	96	56	2	313	524	20,042	21,604
Juab	3,639	1,417	36	24,268	8,996	386,847	730,521
Salt Lake	12,393,829	486,300	117,633	3,163,051	199,431,792	69,849,581	46,202,379
Summit	40,280	11,206	711	468,181	167,581	7,438,804	5,255,063
Tooele	47,987	23,603	1,427	302,229	927,827	8,858,901	7,711,604
Utah	8,853	4,377	503	119,541	55,979	1,872,158	1,196,958
Wasatch	102,358	19,024	4,570	1,424,663	348,830	6,802,893	6,101,792
	12,597,042	545,983	124,882	5,502,246	200,941,529	95,229,226	67,219,921
Total, 1937	23,941,803	910,001	233,494	7,731,431	400,802,359	129,744,655	95,902,500

Gross metal content of Utah concentrates produced in 1938, 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	920	1,644	2,144			
Copper	303,952	98,072	912,729	202,723,147		
Lead	86,226	12,468	3,757,740	3,280,552	90,124,252	8,954,388
Lead-copper	553	8	13,849	59,770	151,988	
Zinc	69,706	3,543	442,428	1,074,120	5,933,919	74,689,574
Iron (from zinc-lead ore)	85,546	10,791	375,500	613,428	3,902,396	4,535,712
	546,903	126,526	5,504,390	207,751,017	100,112,555	88,179,674
Total, 1937	910,572	235,271	7,737,160	414,346,461	137,242,800	128,093,433

Mine production of metals from Utah concentrates in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	56	2	313	524	20,042	21,604
Juab	1,417	36	24,268	8,996	386,847	730,521
Piute	16	259	2,106			
Salt Lake	486,300	117,633	3,163,051	199,431,792	69,849,581	46,202,379
Summit	11,206	711	468,181	167,581	7,438,804	5,255,063
Tooele	24,507	2,812	302,267	927,827	8,858,901	7,711,604
Utah	4,377	503	119,541	55,979	1,872,158	1,196,958
Wasatch	19,024	4,570	1,424,663	348,830	6,802,893	6,101,792
	546,903	126,526	5,504,390	200,941,529	95,229,226	67,219,921
Total, 1937	910,572	235,271	7,737,160	400,802,359	129,744,655	95,902,500

BY CLASSES OF CONCENTRATES

Dry gold	920	1,644	2,144			
Copper	303,952	98,072	912,729	196,641,452		
Lead	86,226	12,468	3,757,740	2,645,158	86,519,296	
Lead-copper	553	8	13,849	50,948	145,899	
Zinc	69,706	3,543	442,428	1,020,148	5,637,225	67,219,921
Iron (from zinc-lead ore)	85,546	10,791	375,500	583,823	2,926,806	
	546,903	126,526	5,504,390	200,941,529	95,229,226	67,219,921

Gross metal content of Utah crude ore shipped to smelters in 1938, 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	85,536	24,965	323,683	736,793	1,419,581	----------
Dry and siliceous gold-silver	184,346	24,620	1,050,385	2,765,447	4,371,173	----------
Dry and siliceous silver	92,543	4,265	1,698,153	888,255	6,277,996	----------
Copper	770	28	6,495	156,722	8,979	----------
Lead	90,287	5,306	1,098,736	828,679	28,724,269	----------
Zinc	83	----------	----------	----------	3,501	45,534
Zinc-lead	117	----------	----------	----------	55,421	61,209
	453,682	59,184	4,177,452	5,375,896	40,860,920	106,743
Total, 1937	509,184	75,928	5,127,834	6,863,337	55,281,997	110,282

Mine production of metals from Utah crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Beaver	5,413	737	33,200	17,231	372,458	----------
Box Elder	132	10	3,174	102	15,913	----------
Grand	3	----------	65	398	----------	----------
Iron	1,255	562	4,902	----------	----------	----------
Juab	151,853	19,485	934,168	1,230,504	4,210,001	----------
Millard	66	7	48	1,184	2,413	----------
Piute	1,785	880	17,585	5,714	23,978	----------
Salt Lake	117,100	12,037	547,865	2,535,779	13,399,006	55,100
San Juan	149	1	181	12,255	----------	----------
Sevier	21	31	1,717	----------	----------	----------
Summit	6,403	396	68,662	13,062	268,370	----------
Tooele	37,696	8,381	103,081	104,275	4,680,469	40,979
Uintah	11	----------	17	1,235	1,261	----------
Utah	131,576	16,656	2,461,686	1,096,235	13,105,320	----------
Wasatch	72	1	1,070	568	5,585	----------
Washington	147	----------	31	71,051	----------	----------
	453,682	59,184	4,177,452	5,089,593	36,084,774	96,079
Total, 1937	509,184	75,928	5,127,834	6,346,553	49,171,345	99,500

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead	Zinc
Dry and siliceous gold	85,536	24,965	323,683	708,936	1,019,338	----------
Dry and siliceous gold-silver	184,346	24,620	1,050,385	2,682,675	3,049,967	----------
Dry and siliceous silver	92,543	4,265	1,698,153	861,575	4,409,627	----------
Copper	770	28	6,495	152,027	6,285	----------
Lead	90,287	5,306	1,098,736	684,380	27,552,017	----------
Zinc	83	----------	----------	----------	3,160	40,979
Zinc-lead	117	----------	----------	----------	44,380	55,100
	453,682	59,184	4,177,452	5,089,593	36,084,774	96,079

REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
			Short tons	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Beaver County:										
Beaver Lake	1		117	2		51	5,286			$621
Bradshaw	1		68	3		2,045	51			1,432
Lincoln	1		18			65	214	6,891	5,479	643
Newton	2		32	22		331	357	1,000		1,065
Pine Grove	1		36	8		560		11,500		1,171
San Francisco	4		4,917	698		27,918	9,857	267,283	11,646	56,298
Star and North Star	6		321	6		2,543	1,990	105,826	4,479	7,132
Box Elder County:										
Ashbrook	4		96	8		3,035	61	2,196		2,349
Grouse Creek	1		3			130	41	65		91
Lucin	1		32			3		13,652		630
Park Valley	2		51	25		14				884
Garfield County: Imperial		5			26					910
Grand County:										
Colorado River		4			17	3				597
Miners Basin	1	1	3		6	65	398			291
Iron County: Stateline	8		1,255	562		4,902				22,839
Juab County:										
Detroit [1]	1		836	198		1,089	17,316			9,331
Fish Springs	4		195	1		18,462	357	146,674		18,752
Spring Creek	2		95	3		2,707	408	1,174		1,949
Tintic [2]	14		154,109	19,257		934,956	1,220,521	4,396,500	730,521	1,635,326
West Tintic	1		257	62		1,222	898	52,500		5,463
Millard County:										
Cricket Mountain	1		1					1,326		61
Detroit [1]	1		61	7		48	1,184			392
Leamington	1		4					1,087		50
Sawtooth Mountains		1			5					175
Piute County:										
Gold Mountain	3		7,647	761		3,646				28,992
Mount Baldy	1		1,451	649		12,822	3,000	9,413		31,731
Ohio	8		261	87		3,465	2,714	14,565		6,221
Salt Lake County:										
Big Cottonwood	4		1,016	38		18,892	57,857	323,022	64,542	37,170
Little Cottonwood	5		2,050	244		20,230	32,092	257,326		36,600
West Mountain [3]	14		12,507,863	129,388		3,671,794	212,098,500	82,668,239	46,192,937	33,707,918

See footnotes at end of table.

Mine production of gold, silver, copper, lead, and zinc in Utah in 1938, by counties and districts, in terms of recovered metals—Continued

County and district	Mines producing		Ore	Gold		Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer					
San Juan County:			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Colorado River		2			18					$630
La Sal	2		149	1		181	12,255			1,353
Sevier County: Henry	1		21	31		1,717				2,195
Summit County: Uintah	8		46,683	1,107		536,843	180,643	7,707,174	5,255,063	1,010,271
Tooele County:										
Camp Floyd	10		211,983	23,001		1,253				805,845
Clifton	8		659	207		7,210	3,816	89,370		16,391
Columbia	1		9			17		1,500		80
Dugway	3		129			396		44,609	14,896	3,023
Free Coinage	1		114			430		55,587		2,835
Lakeside	3		149			198	204	58,478		2,838
North Tintic	1		118			65	51	18,739	40,979	2,876
Ophir	13		21,242	140		144,919	874,102	4,025,543	3,786,812	551,189
Rush Valley	8		41,511	2,173		250,883	153,643	9,238,000	3,909,896	865,922
Silver Islet	1		23			447	286	5,500		570
West Mountain [3]	1		26	8		34				302
Willow Springs	5		32	55		130		2,044		2,103
Uintah County:										
Carbonate	3		11			17	1,235	1,261		190
Green River		9			76	3				2,662
Utah County:										
American Fork	5		1,110	268		6,551	18,765	164,739	85,021	27,113
Tintic [2]	11		139,319	16,891		2,574,676	1,133,449	14,812,739	1,111,937	3,101,459
Wasatch County:										
Blue Ledge	2		90,619	4,429		1,362,520	344,612	4,673,391	3,678,854	1,461,169
Snake Creek	2		11,811	142		63,213	4,786	2,135,087	2,422,938	260,819
Washington County: Tutsagubet	1		147			31	71,051			6,983
Total Utah	183	22	13,248,660	200,482	148	9,682,732	216,252,000	131,314,000	67,316,000	43,745,902

[1] Detroit district lies in both Juab and Millard Counties.
[2] Tintic district lies in both Juab and Utah Counties.
[3] West Mountain district lies in both Salt Lake and Tooele Counties.

BEAVER COUNTY

Lessees continued operations at the Horn Silver mine at Frisco during 1938 and shipped 4,811 tons of ore, chiefly gold-silver ore for smelting; no new development was under way, but the Horn Silver Mines Co. reconditioned and reopened the shaft to the 500-foot level. The remainder of the output from Beaver County comprised small lots of zinc-lead ore shipped to the custom mill at Midvale from the Lincoln, Horn Silver, and Moscow mines and ore shipped for smelting from several properties, including the O. K., Honey Boy, Sheep Rock, Revenue, Frisco Silver-Lead, Quad Metals, Cactus, Good Luck, Beaver Crown, Moscow, Atlas, and Silver Draw.

BOX ELDER COUNTY

The output of silver from Box Elder County decreased markedly in 1938, as lessees at the Vipont mine in the Ashbrook district suspended shipments of silver ore; only 30 tons were shipped compared with more than 1,000 tons in 1937. The remainder of the county output comprised silver ore from the Apex and Liberty Bell (Skoro), Utah-Idaho, and Gold Lead mines; lead ore from the Comstock mine near Lucin; and gold ore from the Raft River and Susannah properties. A small amalgamation plant was operated at the Susannah property for a short time.

IRON COUNTY

The value of the metal output from mines in Iron County in 1938 was less than half that in 1937. The entire output was dry and siliceous ore shipped for smelting; it comprised gold ore from the Creole, Gold Hill, Raindrop, Wonder, Surprise, Center, and Pipe Dream mines and silver ore from the Ophir property.

JUAB COUNTY

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 1938, a comparison of the total with that for 1937, and the total output of the district from 1869 to 1938. The table indicates a decrease in the output of all five metals, mostly at mines in the eastern (Utah County) section.

Mine production of gold, silver, copper, lead, and zinc in Tintic district, Juab and Utah Counties, Utah, 1937–38, and total, 1869–1938, in terms of recovered metals

	Mines producing	Ore	Gold	Silver	Copper	Lead	Zinc	Total value
1938		*Short tons*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Juab County	14	154,109	19,257	934,956	1,220,521	4,396,500	730,521	$1,635,326
Utah County	11	139,319	16,891	2,574,676	1,133,449	14,812,739	1,111,937	3,101,459
	25	293,428	36,148	3,509,632	2,353,970	19,209,239	1,842,458	4,736,785
Total, 1937	34	310,582	51,069	4,030,424	2,662,000	20,396,000	2,517,600	6,594,058
Total, 1869–1938		(1)	2,394,527	244,532,264	229,422,014	1,748,854,741	36,999,120	363,133,791

1 Figures not available.

The Chief Consolidated Mining Co. continued operations in 1938 at the Chief No. 1, Gemini, Eureka Hill, and Plutus mines in Juab County and the Apex Standard mine in Utah County. According to the company printed annual report the output from Juab County comprised 1,464 tons of lead ore, 13,188 tons of silver ore, and 3,827 tons of zinc-lead ore from the Chief No. 1 mine; 4,083 tons of silver ore from the Gemini mine; 2,090 tons of silver ore from the Eureka Hill mine; and 308 tons of lead ore and 2,158 tons of silver ore from the Plutus mine. Total metal production from all mines was given as follows: Gold, 1,575 ounces; silver, 307,696 ounces; copper, 106,233 pounds; lead, 1,278,101 pounds; and zinc, 816,749 pounds. The company reported 3,099 feet of development in the Chief No. 1 mine and 2,564 feet in the Plutus mine. The Centennial-Beck, Victoria, and Eagle & Blue Bell properties were operated continuously by the United States Smelting, Refining & Mining Co.; all the output was crude ore shipped for smelting and comprised about 43,800 tons of gold-silver ore and about 2,900 tons of lead ore, approximately the same as was produced in 1937. The Mammoth Mining Co. operated its property the entire year and produced nearly 40,000 tons of ore (chiefly gold-silver ore) shipped for smelting, a decrease of about 9,000 tons from the 1937 output; development of about 1,100 feet was reported, and dividends totaling $39,532 were paid. The American Smelting & Refining Co. reconditioned the Grand Central mine during 1937 and in 1938 operated from January until the end of August, producing highly siliceous gold-silver ore used as converter flux at the Garfield smelter; company and lessee production totaled more than 28,000 tons of ore, a marked increase over the 1937 output. The remainder of the output from the Juab County section of the Tintic district was crude ore shipped for smelting from the Godiva (3,144 tons of gold ore), Dragon & Martha Washington, Empire Star, Showers, Black Jack, and other properties.

Producing mines in the Utah County section of the Tintic district in 1938 included the Apex Standard, Colorado, Eureka Lilly, Eureka Standard, May Day, North Lily, Tintic Bullion, Tintic Standard, Yankee, and Zuma properties. The Tintic Standard Mining Co. reported an increase in output at the Tintic Standard and Colorado mines, but decreases were reported at the Eureka Standard and Eureka Lilly mines. The following details of shipments by mines and classes of ore were reported in the company printed annual report: Tintic Standard mines, 26,429 tons of lead ore and 57,137 tons of siliceous ore; Eureka Standard mine, 19,659 tons of siliceous ore and 6,252 tons of zinc-lead ore; Eureka Lilly mine, 2,102 tons of siliceous ore and 971 tons of lead ore; and Colorado Consolidated mine, 2,964 tons of siliceous ore. About 11,500 feet of development were reported, chiefly in the Tintic Standard and Eureka Standard mines, and dividends amounting to $342,027 were paid. Development at the Eureka Standard mine opened a body of zinc-lead ore in the Ophir limestone, from which shipments were first made in 1938; prior to this important discovery the entire output of the mine was siliceous gold ore from fissure veins in quartzite. The Tintic Standard mine ranked second in output of silver and lead in Utah in 1938. The North Lily Mining Co. operated the North Lily and Tintic Bullion mines the entire year; each mine produced gold-silver ore and lead ore shipped for smelting and zinc-lead ore sent to the flotation mill at Tooele. The output from the Tintic Bullion mine increased markedly. The remainder of the output from the Utah County section of the Tintic district was ore of smelting grade from the Apex Standard, May Day (Mountain View), Yankee, and Zuma mines and a car of old tailings from the Harold dump of the Standard Reduction Co.

Production from outlying districts in Juab County in 1938 comprised gold ore from the Ibex mine in the Detroit district; rich silver-lead ore from the Emma, Galena, Utah & Last Chance, and Carnation mines at Fish Springs; siliceous ore from the Gold Bond and Premier mines near Spring Creek; and lead ore from the Scotia group in the West Tintic district.

PIUTE COUNTY

The value of the metal output from Piute County dropped more than $110,000 in 1938 due to decreased output of gold ore from the Annie Laurie mine in the Gold Mountain district. The property was operated intermittently by Allied Annie Laurie Gold Mines, Inc., but the ore milled declined from about 20,000 tons in 1937 to 7,574 tons in 1938. Siliceous ore was shipped for smelting from the General Connor and Antler mines in the Gold Mountain district. The Deer Trail mine was closed during part of 1938; lessees shipped 1,451 tons of gold ore for smelting, a decrease from 2,140 tons in 1937. Ore was shipped for smelting from several mines in the Ohio district, including the Gold Strike, Tushar, Bully Boy, Wedge, Desert, Great Western, and Yellow Congo properties.

SALT LAKE COUNTY

Production from the Big Cottonwood district decreased sharply in 1938, as lessees' output from the Cardiff mine was much less than in 1937; other producers were the Wasatch Gold Mines, Inc., Prince of Wales, and Tar Baby properties. In the Little Cottonwood district the Alta United, Columbus, Columbus Rexall, Dipper, and Michigan Utah properties were productive.

Bingham or West Mountain district.—The Bingham district is by far the most important mineral-producing area in Utah, and in 1938 its mines yielded metals valued at $33,707,918, or 77 percent of the State total; the value of the district output, however, decreased 51 percent from that in 1937. The quantity of copper decreased 48 percent, gold 46 percent, silver 25 percent, and lead 9 percent, but zinc increased 12 percent. The following table gives the production from mines at Bingham in 1937 and 1938 and the total from 1865 to 1938.

Mine production of gold, silver, copper, lead, and zinc in Bingham or West Mountain district, Salt Lake County, Utah, 1937–38, and total, 1865–1938, 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*	
1937	15	23, 720, 375	240, 147	4, 873, 479	406,842,000	90, 466, 000	41, 139, 200	$69, 414, 205
1938	14	12, 507, 863	129, 388	3, 671, 794	212,098,500	82, 668, 239	46, 192, 937	33, 707, 918
Total, 1865–1938	--------	(1)	3, 748, 697	108,258,105	[2] 2, 764, 853	[2] 1, 311, 151	[2] 329, 077	1, 164, 623, 948

[1] Figures not available. [2] Short tons.

Most of the decrease in gold, silver, and copper from the Bingham district in 1938 was caused by curtailment by the Utah Copper Co.; the open-cut mine and the Magna and Arthur mills operated at a curtailed rate from January until June 15, when all production was suspended. Operations were resumed August 1 and continued at a reduced rate for the remainder of the year. The company mined and milled 11,704,900 tons of ore in 1938 compared with 23,119,800 tons in 1937, and there were similar decreases in output of copper, gold, silver, and molybdenum. The new vehicular tunnel connecting Bingham and Copperfield was completed and placed in operation in February 1939. The 7,000-foot bore constructed by the Utah Copper Co. at a cost of about $1,400,000 will be used to divert vehicular and pedestrian traffic around the pit, closing the road crossing the pit and allowing bench mining to be started on that side. The American Smelting & Refining Co. operated the Boston Consolidated property of the Utah Copper Co. the entire year; the output comprised about 44,500 tons of smelting ore (gold-silver ore and lead ore) and about 700 tons of zinc-lead ore sent to Midvale for milling.

The United States Smelting, Refining & Mining Co. operated the entire year at the United States & Lark, Niagara, Bingham Metals, and Montana-Bingham properties at Bingham. The output of gold, silver, and lead decreased slightly compared with 1937, but the output of zinc increased considerably owing to higher average content of the ore treated at the Midvale mill. Most of the production was zinc-lead ore from the United States & Lark mine; the property ranked first in output of silver, lead, and zinc in Utah in 1938 and second in gold and copper.

The Ohio Copper Co. operated the new 1,000-ton flotation plant the entire year and treated 326,715 tons of old tailings from former milling operations. According to the company printed annual report, production in 1938 totaled 1,250,730 pounds of copper, 249 ounces of gold, and 3,116 ounces of silver. About 92 percent of the copper came from old tailings milled and the remainder from underground leaching operations on the Mascotte tunnel level.

The Apex-Delaware group was operated by National Tunnel & Mines Co. the entire year; part of the output was by lessees and part on company account. Nearly 40,000 tons of ore were produced, comprising gold ore and lead ore shipped for smelting and zinc-lead ore sent to the flotation mill near Tooele. Work of driving the Elton tunnel was seriously handicapped by a heavy flow of water in the unconsolidated gravel formation, but early in 1939 the bedrock limestone was entered and greater progress was reported; at the end of 1938 the tunnel was in about 6,200 feet of the projected 23,000 feet.

The Combined Metals Reduction Co. operated the Park-Bingham (Lavagnino) group in Butterfield Canyon the entire year, producing 6,770 tons of gold ore and 390 tons of lead ore shipped for smelting and 14,320 tons of zinc-lead ore shipped to the flotation plant at Bauer.

The remainder of the output from the West Mountain district in 1938 included a little zinc-lead ore from the Utah Metal & Tunnel property and a little copper ore from the Bingham Congor mine.

SUMMIT AND WASATCH COUNTIES

PARK CITY REGION

The value of the metal output from mines in the Park City region in 1938 was about one-third that in 1937; the marked decrease was due chiefly to the closing of the Silver King Coalition property early in the year. The following table compares the production from the Park City region in 1937 and 1938 and shows the total for the period 1870 to 1938.

Mine production of gold, silver, copper, lead, and zinc in Park City region, Summit and Wasatch Counties, Utah, 1937–38, and total, 1870–1938, 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*	
1937	11	286,128	7,033	3,132,552	845,215	44,833,712	38,683,200	$7,931,052
1938	12	149,113	5,678	1,962,576	530,041	14,515,652	11,356,855	2,732,259
Total, 1870–1938		(1)	429,790	217,834,168	59,699,840	2,186,999,307	499,397,045	317,903,566

1 Figures not available.

Mining and milling at the Silver King Coalition Mines Co. were suspended April 30, 1938, and the property remained idle until May 1939. According to the company printed annual report production during the first 4 months of 1938 amounted to 35,919 tons of silver-lead-zinc milling ore and 97 tons of rich silver-lead ore of smelting grade; the output of silver, lead, and zinc was about one-fourth that in 1937. Shaft sinking at the new Thaynes shaft continued throughout the year, and at the end of the year the shaft was down 1,379 feet (a total of 907 feet of sinking in 1938); a connection was made on the 900 level of the Silver Hill section. Development at the Silver King property amounted to 9,080 feet. One quarterly dividend of $122,047 was paid April 1, 1938.

Operations at the properties of the Park Utah Consolidated Mines Co. in 1938 were reduced to a one-shift basis January 8 and were completely suspended May 5. As a result, production decreased to 19,144 tons in 1938 from 93,014 tons in 1937. Most of the output was zinc-lead ore shipped to the mill at Tooele from the Judge unit in Wasatch County and the Daly West and Judge properties in Summit County; ore of smelting grade was shipped from the Daly and Ontario properties in Summit County.

According to the printed annual report of the Park City Consolidated Mines Co. the output of silver-zinc-lead ore was 74,650 tons in 1938, an increase from 38,464 tons in 1937; a total of about 6,280 feet of development was done in 1938. The ore was shipped to the flotation plant at Midvale for treatment, and a substantial increase was recorded in output of silver; the property was the third-largest silver producer in Utah in 1938.

The New Park Mining Co., controlled by the Callahan Zinc-Lead Co., operated the entire year at the Park Galena property and shipped

15,969 tons of zinc-lead ore to the mill at Midvale; development at the mine amounted to 1,861 feet, and arrangements were made to reopen the Mayflower tunnel and extend it about 1,600 feet to open the Park Galena fissure at a depth of 760 feet below the present main tunnel.

The remainder of the output from the Park City region in 1938 comprised small lots of ore from the New Quincy, Keystone, and Park Flag properties and old tailings from Silver Creek.

TOOELE COUNTY

Camp Floyd (Mercur) district.—The output of gold from Mercur increased from 14,016 ounces in 1937 to 23,001 ounces in 1938, as a result of increased output by both Snyder Mines, Inc., and Geyser Marion Gold Mining Co. Snyder Mines, Inc., operated the remodeled Manning mill from January to October and treated more than 85,000 tons of ore from the Con Mercur property by combined cyanidation and flotation; in addition, the company and lessees shipped 21,150 tons of gold ore for smelting. The Con Mercur mine was the third-largest producer of gold in Utah in 1938. The mill also treated by straight cyanidation about 5,100 tons of oxidized custom ore from five properties in the district. The Geyser Marion Gold Mining Co. completed the installation of new crushing, leaching, and precipitation equipment at the Sacramento and Geyser Marion properties, increasing the capacity of the two plants to about 800 tons of ore a day. The mills handled 65,251 tons of low-grade gold ore from the Geyser Marion open-cut mine and 34,529 tons of custom ore, including 27,157 tons from the Sacramento mine; the ore was treated by straight cyanidation. Other producers in the Camp Floyd district in 1938 included the Golden Gate, Herschel, Boston Sunshine, West Dip, McCornick, Rover, and Silver Lode properties; most of the output from these mines was treated at the two custom mills, but in addition gold ore was shipped crude for smelting from the West Dip and Boston Sunshine mines.

Clifton (Gold Hill) district.—Crude ore was shipped for smelting in 1938 from several mines in the Gold Hill district, including the Clifton Standard, Garrison, Gold Spar, Midas, New Baltimore, Rube No. 3, and Success.

Ophir and Rush Valley districts.—The value of the metal output from the Stockton-Ophir region decreased more than $1,160,000 in 1938, owing to decreases at the Hidden Treasure mine and at the properties operated by the Combined Metals Reduction Co. The Hidden Treasure property near Ophir was sold during the year to the United States Smelting, Refining & Mining Co.; production was suspended in July and was not resumed until early in 1939 after completion of an extensive reconditioning and development program. The output in 1938 was 13,742 tons of zinc-lead ore shipped to Midvale for milling, a decrease from 27,702 tons in 1937. The Ophir Development Co. continued work at the Ophir Hill mine, shipping 2,112 tons of zinc-lead ore to the mill at Tooele and 218 tons of lead ore for smelting. The International Smelting & Refining Co. completed the erection of a 600-ton flotation plant at the Ophir Hill tailings dump and placed the plant in operation November 21; about 5,000 tons of tailings were treated by the end of the year, and copper-lead concentrates were shipped to Tooele for smelting. Much of the equipment used in the construction of the mill was salvaged from the old Utah-Apex mill at Bingham, which was dismantled during 1938.

The Combined Metals Reduction Co. curtailed operations at the Cyclone (Bluestone), Honerine, and West Calumet mines in 1938, and the output of lead ore and zinc-lead ore was much less than in 1937; the output from the Cyclone mine decreased from about 15,000 to 8,429 tons and lead ore and zinc-lead ore from the Honerine and West Calumet mines from more than 42,000 to about 32,600 tons. The lead ore from all three properties was shipped to Tooele for smelting, and the zinc-lead ore was milled in the flotation plant at Bauer. Other producers in the Stockton-Ophir region included the Kearsarge, Lakes of Killarney, Tintic Ophir, Ophir, Zella, Mono, Commodore, Circle, and Hercules mines.

Other producing mines in Tooele County in 1938 included the Benmore property in the Columbia district; the Humdinger (Lead Ore) mine in the Free Coinage district; the Georgia Lyn, Monarch, and Lone Star mines at Lakeside; the Scranton mine in the North Tintic district; the Silver Island mine north of Wendover; the Combination mine in Pine Canyon in the West Mountain district; and the Eagle's Nest, Oro Del Rey, Liberty, Depression, and Imperial mines in the Willow Springs district.

UTAH COUNTY

American Fork district.—The value of the metal output from the American Fork district decreased $91,205 in 1938, as the output from the Live Yankee mine declined. The property is owned by the American Smelting & Refining Co., and lessees' shipments of gold ore and zinc-lead ore declined from about 4,300 to 877 tons. Other producers in the American Fork district in 1938 included the Blue Rock (Pacific), Dutchman, and Bog Iron mines.

Tintic district.—The mines in the Utah County section of the Tintic district are reviewed under Juab County.

WASHINGTON COUNTY

The Dixie (Apex) mine in the Tutsagubet district, operated by the Utah Southern Mining Co., was the only producer in Washington County in 1938; the company shipped 147 tons of copper ore to Garfield for smelting.

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 in 1938 was $5,510,440, or more than double the value of the 1937 output ($2,253,054), and was the largest in the history of mining in the State. Substantial increases were recorded in the output of all five metals, especially gold and copper. Of outstanding interest was the starting in April of the new mill at the Holden property in Chelan County by the Howe Sound Co. The company mined and milled 371,800 tons of ore and was the largest producer of gold, silver, and copper in Washington in 1938. The output of gold from Ferry and Stevens Counties increased considerably, owing chiefly to regular operation of cyanide mills at Republic and Orient. Lead and zinc production from Pend Oreille County increased owing to a larger output of zinc-lead ore from two mines near Metaline Falls.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	$34.95	[4] $0.646+	$0.080	$0.037	$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.

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

[4] $0.64646464.

Mine production of gold, silver, copper, lead, and zinc in Washington, 1934–38, and total, 1860–1938, 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
1934	62	210	47,902	8,301.83	$290,149	44,120	$28,522
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
1860–1938			(1)	1,624,993.00	35,630,078	10,013,622	7,095,512

Year	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
1934	13,900	$1,112	581,298	$21,508	3,852,419	$165,654	$506,945
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
1860–1938	[2] 19,768	6,057,509	[2] 43,100	5,456,646	[2] 40,277	4,238,810	58,478,555

[1] 1860–1903: Figures not available; 1904–38: 3,634,402 tons produced. [2] Short tons.

Gold and silver produced at placer mines in Washington, 1934–38, in terms of recovered metals

Year	Gold		Silver		Total value
	Fine ounces	Value	Fine ounces	Value	
1934	1,773.45	$61,982	317	$205	$62,187
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

Gold.—The output of gold in Washington increased from 36,310 fine ounces in 1937 to 74,175 ounces in 1938. Most of the gain was in Chelan County and was due to the starting of milling operations by the Howe Sound Co. The company treated 371,800 tons of gold-copper-silver ore in 1938 and was by far the largest gold producer in the State. Gold production from Ferry County increased 7,534 ounces owing to continuous operation of the Knob Hill cyanide plant and increased shipments of smelting ore from other mines at Republic. The gold output of Stevens County increased 1,763 ounces; most of it came from the First Thought cyanidation mill near Orient. Gold production from Whatcom and Okanogan Counties decreased. Gold ore treated at gold and silver mills increased to 212,161 tons in 1938, from 142,790 tons in 1937, and yielded 40 percent of the total gold produced; gold ore smelted (56,896 tons) yielded 16 percent; and copper ore concentrated (373,000 tons) yielded 41 percent. Most of the gold ore shipped for smelting came from the Aurum, Mountain Lion, Republic, and Quilp mines in the Republic district, Ferry County, but nearly 11,000 tons of low-grade gold ore from a property near Wenatchee, Chelan County, was shipped as siliceous flux to the smelter at

Tacoma. No large placer operations were reported in Washington in 1938, but gold output from placers increased to 1,575 ounces, most of which came from operations along the Columbia River, chiefly in Stevens and Ferry Counties on ground that will later be submerged under Grand Coulee Reservoir.

Silver.—The output of recoverable silver in Washington in 1938 was three times that in 1937. Nearly half of the increase was from copper ore (chiefly from Chelan County), but substantial increases also came from silver ore (chiefly from the Arlington mine in Okanogan County) and from gold ore from mines at Republic. The Chelan Division of the Howe Sound Co. was the largest silver producer in Washington in 1938, followed by the Arlington mine near Okanogan and the Knob Hill, Aurum, and Quilp mines at Republic; other important producers were the Silver Queen (Ark Mines Co.) mine at Kettle Falls and the Josephine mine near Metaline Falls. Gold ore and copper ore each yielded 33 percent of the total silver produced, and silver ore yielded 29 percent; ore concentrated yielded 65 percent, ore smelted nearly 20 percent, and ore to gold and silver mills 15 percent.

Copper.—The output of recoverable copper in Washington in 1938 was by far the largest in the history of the State and came chiefly from the Holden mine, operated by the Chelan Division of the Howe Sound Co. Most of the small remainder of the copper produced in the State came from three mines in Okanogan and Snohomish Counties. No production was reported from the Royal mine north of Leavenworth, Chelan County. The new flotation plant of the Holden property was placed in operation in April 1938. The capacity of the mill was increased during the summer and fall, and by the end of the year the mill was treating 2,000 tons of copper-gold-silver ore a day. Copper concentrates rich in gold and silver were shipped to Tacoma for smelting.

Lead and zinc.—The output of recoverable lead and zinc in Washington increased markedly in 1938 owing to an increase of more than 143,000 tons in the output of zinc-lead ore from two mines near Metaline Falls. All the zinc and nearly 94 percent of the lead produced in Washington came from the properties of the Pend Oreille Mines & Metals Co. and the Metaline Mining & Leasing Co. near Metaline Falls; most of the remainder of the lead output came from properties near Northport, Stevens County.

MINE PRODUCTION BY COUNTIES

Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties, in terms of recovered metals

County	Mines producing		Ore (short tons)	Gold				Silver (lode and placer)	
	Lode	Placer		Lode: Fine ounces	Placer: Fine ounces	Total: Fine ounces	Total: Value	Fine ounces	Value
Asotin		9			107	107	$3,745	14	$9
Benton		3			34	34	1,190	3	2
Chelan	2	3	382,646	31,525	9	31,534	1,103,690	124,590	80,543
Clallam		2			9	9	315		
Douglas		2			36	36	1,260	3	2
Ferry	15	7	207,074	25,654	244	25,898	906,430	119,688	77,374
Grant		3			23	23	805	3	2
Grays Harbor		1			1	1	35		
King	3		824	184		184	6,440	2,048	1,324
Kittitas	4	8	51	20	65	85	2,975	17	11
Lincoln		3			13	13	455		
Okanogan	23	10	9,561	1,110	128	1,238	43,330	85,731	55,422
Pend Oreille	2	3	249,184		7	7	245	14,584	9,428
Skamania	1		5	25		25	875	3	2
Snohomish	2	6	1,143	11	28	39	1,365	1,123	726
Stevens	19	17	14,180	1,781	839	2,620	91,700	31,677	20,478
Whatcom	5	2	36,871	12,289	5	12,294	430,290	1,352	874
Whitman		1			27	27	945	3	2
Yakima	1		150	1		1	35	99	64
	77	80	901,689	72,600	1,575	74,175	2,596,125	380,938	246,263
Total, 1937	65	90	294,826	35,939	371	36,310	1,270,850	126,304	97,696

County	Copper		Lead		Zinc		Total value
	Pounds	Value	Pounds	Value	Pounds	Value	
Asotin							$3,754
Benton							1,192
Chelan	11,861,000	$1,162,378					2,346,611
Clallam							315
Douglas							1,262
Ferry	4,000	392	1,761	$81			984,277
Grant							807
Grays Harbor							35
King	1,347	132	5,500	253			8,149
Kittitas							2,986
Lincoln							455
Okanogan	35,061	3,436	43,826	2,016			104,204
Pend Oreille			8,018,500	368,851	22,804,000	$1,094,592	1,473,116
Skamania							877
Snohomish	114,245	11,196					13,287
Stevens	14,000	1,372	498,413	22,927			136,477
Whatcom							431,164
Whitman							947
Yakima	4,347	426					525
	12,034,000	1,179,332	8,568,000	394,128	22,804,000	1,094,592	5,510,440
Total, 1937	128,000	15,488	5,660,000	333,940	8,232,000	535,080	2,253,054

MINING INDUSTRY

Metal mining in Washington was more active in 1938 than in any year of its history. The total value of the output was much larger than in any previous year, and new records were established in output of gold, copper, and zinc; output of lead very nearly attained the previous record. Such gains are entirely the result of large capital expenditures during 1936, 1937, and 1938, and the most important of these is the Holden enterprise of the Howe Sound Co. which includes complete mining, milling, power, and transportation facilities for an operation of 2,000 tons daily capacity; other expenditures, made prior to 1938 (the first full year of operation), include new cyanide mills at Republic, Orient, and Azurite and new power and milling capacity at Metaline Falls. All the large increases in output were made at properties that have new or recently improved physical plants, and as a result of these improvements the value of the State output in 1938 was more than five times that in 1936.

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 1938, 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	49	271,557	41,869	127,395	7,038	7,897	
Dry and siliceous gold-silver ore	2	61	6	499	58	740	
Dry and siliceous silver ore	6	7,229	73	110,620	41,783	58,979	
	57	278,847	41,948	238,514	48,879	67,616	
Copper ore [1]	5	373,120	30,650	124,307	11,983,694		
Lead ore	13	538	2	3,315	1,427	481,884	
Zinc-lead ore	2	249,184		14,584		8,018,500	22,804,000
Total, lode mines	77	901,689	72,600	380,720	12,034,000	8,568,000	22,804,000
Total, placers	80		1,575	218			
	157	901,689	74,175	380,938	12,034,000	8,568,000	22,804,000
Total, 1937	155	294,826	36,310	126,304	128,000	5,660,000	8,232,000

[1] By far the greatest part of this ore is an unusual copper- [gold-silver] ore necessitating a close decision between "copper ore" and "gold ore" according to Bureau of Mines Minerals Yearbook classification.

METALLURGIC INDUSTRY

The total output of ore in Washington in 1938 was 901,689 tons; it comprised 212,161 tons treated at gold and silver mills, 631,864 tons treated at concentration plants, and 57,664 tons shipped crude to smelters.

Gold and silver mills.—Seven small straight amalgamation plants treated 2,071 tons of gold ore, recovering 439 ounces of gold and 230 ounces of silver in amalgamation bullion and 58 tons of gold concentrates yielding 111 ounces of gold and 190 ounces of silver.

Three straight cyanidation plants and one combined cyanidation and corduroy-concentration plant treated 210,090 tons of ore containing (original or gross contents) 31,550 ounces of gold and 67,857 ounces of silver; the cyanide precipitates yielded 27,061 ounces of gold and 57,663 ounces of silver and the concentrates yielded 2,344 ounces of gold and 213 ounces of silver, indicating average over-all recoveries of 93 percent of the gold and 85 percent of the silver. Cyanidation reagents consumed at the four plants comprised 201,992 pounds of sodium cyanide (91-percent grade), 28,480 pounds of Aero Brand calcium cyanide, 41,822 pounds of zinc dust, and 1,205,082 pounds of lime; other reagents reported included lead acetate, litharge, soda ash, and starch.

Concentration plants.—The 631,864 tons of ore treated at concentration plants comprised 373,000 tons of copper ore treated at three plants, 249,184 tons of zinc-lead ore at two plants, 7,180 tons of silver ore at three plants, and 2,500 tons of gold ore at four plants.

Details of the treatment of all ore produced in Washington in 1938 are given in the following tables.

Mine production of metals in Washington in 1938, 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	2,071	439	230			
Ore cyanided	210,090	27,061	57,663			
Concentrates smelted	52,335	33,549	248,414	11,991,876	8,080,690	22,804,000
Ore smelted	57,664	11,551	74,413	42,124	487,310	
Placer		1,575	218			
		74,175	380,938	12,034,000	8,568,000	22,804,000
Total, 1937		36,310	126,304	128,000	5,660,000	8,232,000

Mine production of metals from amalgamation and cyanidation mills (with or without concentration equipment) in Washington in 1938, by types of mills and by counties, in terms of recovered metals

County	Ore treated	Recovered in bullion		Concentrates smelted and recovered metal		
		Gold	Silver	Concentrates produced	Gold	Silver
	Short tons	*Fine ounces*	*Fine ounces*	*Short tons*	*Fine ounces*	*Fine ounces*
AMALGAMATION MILLS						
Kittitas	46	19	3			
Okanogan	1,840	332	196	58	111	190
Skamania	5	25	3			
Stevens	30	17	20			
Whatcom	150	46	8			
	2,071	439	230	58	111	190
Total, 1937	20,375	2,449	1,278	143	200	449
CYANIDATION MILLS						
Ferry	161,907	15,776	55,600			
Stevens	11,668	1,723	963			
Whatcom	36,515	9,562	1,100	24	2,344	213
	210,090	27,061	57,663	24	2,344	213
Total, 1937	122,415	20,170	33,333	38	3,653	308
Grand total: 1938	212,161	27,500	57,893	82	2,455	403
1937	142,790	22,619	34,611	181	3,853	757

Mine production of metals from concentrating mills in Washington in 1938, 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	371,800	25,592	30,635	122,132	11,861,000	----------	----------
King	800	114	176	1,593	1,241	4,552	----------
Okanogan	7,030	442	269	82,933	33,474	38,560	----------
Pend Oreille	249,184	25,838	----------	14,584	----------	8,018,500	22,804,000
Snohomish	1,050	175	9	1,035	82,990	----------	----------
Stevens	1,850	81	4	25,635	8,824	19,078	----------
Yakima	150	11	1	99	4,347	----------	----------
	631,864	52,253	31,094	248,011	11,991,876	8,080,690	22,804,000
Total, 1937	114,566	11,355	80	31,556	103,420	5,282,495	8,232,000

Gross metal content of Washington concentrates produced in 1938, 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 and siliceous	233	2,824	5,745	2,399	10,452	----------
Copper	26,181	30,712	205,697	12,350,721	73,596	----------
Lead	5,121	10	14,763	98	7,987,634	223,548
Lead-copper	71	3	22,209	10,851	19,310	----------
Zinc	20,729	----------	----------	----------	447,062	25,338,773
	52,335	33,549	248,414	12,364,069	8,538,054	25,562,321
Total, 1937	11,536	3,933	32,313	106,677	5,561,980	9,257,510

Mine production of metals from Washington concentrates in 1938, in terms of recovered metals

BY COUNTIES

	Concentrates	Gold	Silver	Copper	Lead	Zinc
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*
Chelan	25,592	30,635	122,132	11,861,000	----------	----------
King	114	176	1,593	1,241	4,552	----------
Okanogan	500	380	83,123	33,474	38,560	----------
Pend Oreille	25,838	----------	14,584	----------	8,018,500	22,804,000
Snohomish	175	9	1,035	82,990	----------	----------
Stevens	81	4	25,635	8,824	19,078	----------
Whatcom	24	2,344	213	----------	----------	----------
Yakima	11	1	99	4,347	----------	----------
	52,335	33,549	248,414	11,991,876	8,080,690	22,804,000
Total, 1937	11,536	3,933	32,313	103,420	5,282,495	8,232,000

BY CLASSES OF CONCENTRATES

Dry and siliceous	233	2,824	5,745	2,187	5,165	----------
Copper	26,181	30,712	205,697	11,980,930	36,800	----------
Lead	5,121	10	14,763	78	7,662,357	----------
Lead-copper	71	3	22,209	8.681	18,538	----------
Zinc	20,729	----------	----------	----------	357,830	22,804,000
	52,335	33,549	248,414	11,991,876	8,080,690	22,804,000

Gross metal content of Washington crude ore shipped to smelters in 1938, 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	57,006	11,544	70,057	5,603	7,260
Copper	120	5	1,041	36,438	
Lead	538	2	3,315	1,707	502,352
	57,664	11,551	74,413	43,748	509,612
Total, 1937	37,470	9,387	59,332	25,529	394,067

Mine production of metals from Washington crude ore shipped to smelters in 1938, in terms of recovered metals

BY COUNTIES

	Ore	Gold	Silver	Copper	Lead
	Short tons	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*
Chelan	10,846	890	2,458		
Ferry	45,167	9,878	64,057	4,000	1,761
King	24	8	455	106	948
Kittitas	5	1			
Okanogan	691	398	2,384	1,587	5,266
Snohomish	93	2	85	31,255	
Stevens	632	37	4,943	5,176	479,335
Whatcom	206	337	31		
	57,664	11,551	74,413	42,124	487,310
Total, 1937	37,470	9,387	59,332	24,580	377,505

BY CLASSES OF ORE

	Ore	Gold	Silver	Copper	Lead
Dry and siliceous	57,006	11,544	70,057	5,340	5,426
Copper	120	5	1,041	35,357	
Lead	538	2	3,315	1,427	481,884
	57,664	11,551	74,413	42,124	487,310

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REVIEW BY COUNTIES AND DISTRICTS

Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties and districts, in terms of recovered metals

County and district	Mines producing		Ore	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*	
Asotin County: Snake River	----	9	----	----	107	107	14	----	----	----	$3,754
Benton County: Columbia River	----	3	----	----	34	34	3	----	----	----	1,192
Chelan County:											
Chelan	1	----	371,800	30,635	----	30,635	122,132	11,861,000	----	----	2,313,557
Wenatchee	1	3	10,846	890	9	899	2,458	----	----	----	33,054
Clallam County: Ozette	----	2	----	----	9	9	----	----	----	----	315
Douglas County: Columbia River	----	2	----	----	36	36	3	----	----	----	1,262
Ferry County:											
Columbia River	----	5	----	----	241	241	31	----	----	----	8,455
Danville	1	----	155	65	----	65	82	4,000	----	----	2,720
Enterprise	1	----	4	----	----	----	181	----	1,761	----	198
Republic	13	2	206,915	25,589	3	25,592	119,394	----	----	----	972,904
Grant County: Columbia River	----	3	----	----	23	23	3	----	----	----	807
Grays Harbor County: Pacific Beach	----	1	----	----	1	1	----	----	----	----	35
King County: Miller River	3	----	824	184	----	184	2,048	1,347	5,500	----	8,149
Kittitas County: Swauk	4	8	51	20	65	85	17	----	----	----	2,986
Lincoln County: Columbia River	----	3	----	----	13	13	----	----	----	----	455
Okanogan County:											
Cascade	3	----	1,696	517	----	517	628	51	913	----	18,548
Columbia River	----	4	----	----	62	62	14	----	----	----	2,179
Conconully	2	----	17	----	----	----	775	704	3,000	----	708
Methow	5	----	1,570	230	----	230	399	1,296	174	----	8,443
Myers Creek and Mary Ann Creek	5	1	286	159	3	162	198	10	826	----	5,837
Palmer Mountain	8	----	5,992	204	----	204	83,703	33,000	38,913	----	66,275
Similkameen River	----	5	----	----	63	63	14	----	----	----	2,214
Pend Oreille County: Metaline	2	3	249,184	----	7	7	14,584	----	8,018,500	22,804,000	1,473,116
Skamania County: Niggerhead	1	----	5	25	----	25	3	----	----	----	877
Snohomish County:											
Index	1	----	1,050	9	----	9	1,035	82,990	----	----	9,117
Sultan	1	6	93	2	28	30	88	31,255	----	----	4,170
Stevens County:											
Bossburg	2	----	18	----	----	----	362	----	4,826	----	456
Chewelah	1	----	27	3	----	3	956	4,102	----	----	1,125
Columbia River	----	17	----	----	839	839	116	----	----	----	29,440
Colville	2	----	46	4	----	4	1,321	143	4,413	----	1,211
Kettle Falls	4	----	1,725	18	----	18	22,275	8,755	18,826	----	16,754

Mine production of gold, silver, copper, lead, and zinc in Washington in 1938, by counties and districts, in terms of recovered metals—Continued

County and district	Mine producing		Ore	Gold			Silver (lode and placer)	Copper	Lead	Zinc	Total value
	Lode	Placer		Lode	Placer	Total					
Stevens County—Continued.			*Short tons*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Fine ounces*	*Pounds*	*Pounds*	*Pounds*	
Northport	5		483				2,076	857	467,261		$22,920
Orient	3		11,718	1,755		1,755	1,007				62,076
Springdale	2		163	1		1	3,564	143	3,087		2,495
Whatcom County:											
Mount Baker	2	2	53	33	5	38	17				1,341
Slate Creek	3		36,818	12,256		12,256	1,335				429,823
Whitman County: Snake River		1			27	27	3				947
Yakima County: Bumping Lake	1		150	1		1	99	4,347			525
Total Washington	77	80	901,689	72,600	1,575	74,175	380,938	12,034,000	8,568,000	22,804,000	5,510,440

ASOTIN COUNTY

The entire output of gold and silver from Asotin County in 1938 came from placer operations along the Snake River near Asotin and Clarkston; the output increased considerably owing to the operation of a small dragline and washer near Clarkston.

BENTON COUNTY

Three placers on the Columbia River near Paterson and Richland were active in 1938. Most of the output came from the mechanical washing plant of the Gone Busted placer on Blalock Island near Paterson.

CHELAN COUNTY

Chelan district.—The Holden mine, high in the Cascade Mountains about 54 miles northwest of Chelan, has long been known as a potential producer of copper, gold, and silver, but inadequate transportation and power facilities greatly retarded development. The property was acquired by the Howe Sound Co. in 1930, and the Chelan Division of the company was formed to operate it. After an extensive period of exploration and mine development, actual construction of the mining and milling plants was started in 1937. The new plant, with an initial capacity of 1,000 tons a day, was placed in operation April 1, 1938. Supplementary construction included a 53-mile electric transmission line, docks, roads, miscellaneous camp buildings, etc. During the summer and fall of 1938 the mill was enlarged, and by the end of the year it was treating 2,000 tons of ore daily by flotation concentration. The concentrates are hauled by truck to Lucerne, a landing on Chelan Lake, and thence by barge to Chelan and by rail to Tacoma for smelting. The gold content of the concentrates produced is unusually high for copper ores and is nearly as valuable as the copper content; considerable silver also is recovered. During 1938 the company milled 371,800 tons of ore and was by far the most important mining operation in the State; the mine ranked first in output of gold, silver, and copper. Nearly 16,000 feet of mine development was done during 1938, and employment was provided for an average of 413 men.

The American Smelting & Refining Co. operated a property near Wenatchee during the last quarter of 1938 and shipped nearly 11,000 tons of highly siliceous low-grade gold ore to the smelter at Tacoma. The material is used as siliceous flux in the copper-smelting operations, replacing barren siliceous material (beach sands) in the furnace charges.

FERRY COUNTY

Republic district.—Mines in the Republic district produced gold and silver valued at $972,904 in 1938 compared with $698,693 in 1937. Knob Hill Mines, Inc., was again the largest producer at Republic; the company operated the new 400-ton cyanide plant the entire year, treating 147,514 tons of ore from the Knob Hill property and 4,565 tons of old tailings from the Mountain Lion property, which was acquired during the year. No crude ore was shipped from the Knob Hill, but about 8,300 tons of smelting ore were shipped from the Mountain Lion. The Eureka Mining & Milling Co. continued operation of both the Quilp and Republic groups; the cyanide mill treated 9,828 tons of Quilp ore during the first 5 months of the year, but the plant was closed and dismantled after June 1; shipments of crude ore to smelters continued throughout the year from both the Quilp and Republic mines. Lessees continued shipments of gold ore of smelting grade from various properties of the Aurum Mining Co. during 1938; the company resumed development late in the year, and a mill was reported under consideration for the Last Chance group. The remainder of the district lode production was siliceous ore shipped for smelting from several properties, including the California, El Caliph, Golden Harvest, Morning Glory, Opal, and Seattle mines. The ore of smelting grade was shipped to Tacoma, Wash., and Trail, British Columbia.

The remainder of the output from Ferry County comprised gold ore shipped for smelting by the Morning Star Mining Co. at Danville; lead ore from the Lucky Boy mine near Inchelium; and placer dust and retorts from operations along the Columbia River and at Republic, chiefly from the Plumb Bar near Keller.

KING COUNTY

Apex Gold Mines, Inc., started milling operations at its property in the Miller River district in 1938; several hundred tons of gold ore were treated in the 75-ton flotation plant, and gold concentrates were shipped to Tacoma. Siliceous ore was shipped for smelting from the Coney Basin and Cleopatra & Aces Up properties, also in the Miller River district.

KITTITAS COUNTY

Small lots of placer dust were marketed in 1938 from several properties on Swauk Creek, chiefly from the Sunny Bar property; producing lode mines included the Mountain Daisy, Wall Street, and Ione Fraction.

OKANOGAN COUNTY

Suspension of operations by the Northern Gold Corporation at the Bodie mine near Wauconda (Cascade district) early in 1938 resulted in a sharp decrease in gold production from Okanogan County. An increase was recorded at the Arlington property in the Palmer Mountain district, as Arlington Mines, Inc., remodeled the flotation plant and milled 5,330 tons of silver ore; concentrates rich in copper and silver were shipped to Tacoma. Other producing lode mines in Okanogan County in 1938 included the Whitestone and Golconda mines in the Cascade district; the Chief Sunshine and Seven Devils mines near Conconully; the Mazama Queen and Red Shirt mines in the Methow district; the Mother Lode, Overtop, Gray Eagle, and Peterson mines in the Myers Creek and Mary Ann Creek district; and the Hiawatha, John Judge, Triune, American Rand, and Owasco mines in the Palmer Mountain district. Placer production was reported from properties along the Columbia and Similkameen Rivers and from Myers Creek and Mary Ann Creek.

PEND OREILLE COUNTY

Metaline district.—The Pend Oreille Mines & Metals Co. operated its mine and 600-ton flotation plant near Metaline Falls continuously during 1938 and treated 214,120 tons of zinc-lead ore, the greatest output in the history of the company; the flotation plant was enlarged during 1937 and operated at capacity during 1938. The Metaline Mining & Leasing Co. operated its mine for 5 months (January, February, March, November, and December) in 1938 and treated 35,064 tons of zinc-lead ore in the 300-ton flotation plant. The products (lead concentrates and zinc concentrates) of the two mills were shipped to reduction plants outside the State for treatment. The combined output of the two mines was the largest in the history of Pend Oreille County and established a new record zinc output for the State.

SNOHOMISH COUNTY

Copper ore was produced in 1938 at the Sunset mine in the Index district and the Florence Rae mine in the Sultan district. Placer dust was recovered at several properties along the Sultan River.

STEVENS COUNTY

The First Thought Mine Corporation operated the 50-ton cyanidation plant near Orient throughout 1938 and treated 11,668 tons of gold ore, an increase from 4,683 tons in 1937; cyanide bullion yielding 1,723 ounces of gold and 963 ounces of silver was marketed. The Ark Mines Co. operated the Silver Queen property near Kettle Falls and treated about 1,700 tons of silver ore by flotation, shipping lead-copper concentrates to Kellogg, Idaho, for smelting. Other producing lode mines in Stevens County included the Young America and Silver Trail mines near Bossburg; the Copper King mine at Chewelah; the Old Dominion and Middleport mines at Colville; the Electric Point, Red Top, Melrose, and Burrus mines in the Northport district; the McNally mine at Orient; and the Queen Seal and Cleveland mines near Springdale. Placer operations along the Columbia River in Stevens County accounted for the bulk of the State placer output; most of it came from the Collins, Grover, Gibson, and B & W properties. Much of the placer ground on the Columbia River in Stevens and Ferry Counties ultimately will be submerged by the reservoir created by Grand Coulee Dam.

The General Electric Co. operated the Germania mine near Springdale the entire year and treated 28,641 tons of tungsten ore in the 100-ton concentration plant. A little molybdenum ore was produced at the Monitor mine east of Fruitland by the Deertrail Monitor Mines Co.

WHATCOM COUNTY

The American Smelting & Refining Co. continued regular operations at the Azurite mine in the Slate Creek district during 1938 and treated 36,515 tons of gold ore in the 100-ton cyanidation and corduroy-table concentration mill; cyanide bullion yielded 9,562 ounces of gold and 1,100 ounces of silver, and 24 tons of concentrates yielded 2,344 ounces of gold and 213 ounces of silver. The Boundary Red Mountain mine in the Mount Baker district was not operated in 1938, but a little mill clean-up material was amalgamated. Gold ore from the New Light mine was also amalgamated, and gold ore was shipped for smelting from the Gold Run and Allen Basin mines.

YAKIMA COUNTY

The Copper Mining Co. treated 150 tons of copper ore in a small concentrator and shipped 11 tons of copper concentrates for smelting; the company also produced a small quantity of tungsten concentrates.

GOLD, SILVER, COPPER, AND LEAD IN WYOMING

(MINE REPORT)

By Chas. W. Henderson and A. J. Martin

SUMMARY OUTLINE

The annual gold production of Wyoming dropped below 1,000 ounces in 1938 for the first time since the dragline dry-land dredge method of mining placer deposits was introduced in the State in 1933. In that year and in each succeeding year through 1938 placers worked by this method have yielded most of the State gold. The only silver produced in Wyoming in 1938 that was not a byproduct of gold mining was 34 ounces contained in silver ore shipped from the Sunlight district, Park County. The Atlantic City district, Fremont County, continued to be the principal gold-producing district of the State. No recoverable copper or lead has been produced in Wyoming since 1935.

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, 1934–38

Year	Gold [1]	Silver [2]	Copper [3]	Lead [3]	Zinc [3]
	Per fine ounce	*Per fine ounce*	*Per pound*	*Per pound*	*Per pound*
1934	\$34.95	[4] \$0.646+	\$0.080	\$0.037	\$0.043
1935	35.00	.71875	.083	.040	.044
1936	35.00	.7745	.092	.046	.050
1937	35.00	.7735	.121	.059	.065
1938	35.00	[4] .646+	.098	.046	.048

[1] 1934: Yearly average weighted Government price; 1935–38: 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] 1934 and 1938: Treasury buying price for newly mined silver; 1935–37: Yearly average weighted Treasury buying price for newly mined silver.
[3] Yearly average weighted price of all grades of primary metal sold by producers.
[4] \$0.64646464.

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 1934 to 1938; it also gives the total metal production from 1867 to 1938. 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, 1934–38, and total, 1867–1938, 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	
1934	8,173	4,871.36	$170,254	710	$459	3,500	$280	2,000	$74	$171,067
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
1867–1938	(1)	76,090.00	1,771,478	74,297	51,516	[2] 16,319	5,682,652	[2] 8	568	7,506,214

[1] Figures not available.
[2] Short tons.

MINE PRODUCTION BY COUNTIES

Mine production of gold and silver in Wyoming in 1938, 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		3			42.20	42.20		5	5	$1,480
Carbon	1	3	30	19.40	11.60	31.00	6	1	7	1,090
Fremont	6	18	550	174.20	546.40	720.60	209	73	282	25,403
Park	1		1				34		34	22
Sheridan		1			1.60	1.60				56
Teton		1			2.60	2.60				91
	8	26	581	193.60	604.40	798.00	249	79	328	28,142
Total, 1937	3	27	17	164.60	1,611.40	1,776.00	13	190	203	62,317

REVIEW BY COUNTIES AND DISTRICTS

ALBANY COUNTY

Douglas Creek district (Holmes, Keystone).—The Clark's Fork Co. moved its dragline and dry-land dredge from Clark Fork, Park County, to placer ground on Douglas Creek 3 miles from Holmes, Albany County, and operated them from August 15 to November 1, 1938. Individuals sluicing on streams near Holmes recovered small quantities of gold.

CARBON COUNTY

Encampment or Upper Platte district.—A car of gold ore was shipped from the Golden Clover property to the Garfield (Utah) smelter in June 1938.

Spring Creek district.—The Saratoga Mining Co. installed machinery for placer mining on the Phillips placer on North Spring Creek and operated for a period in 1938. Small-scale placering was done by individuals on Spring and Savery Creeks.

FREMONT COUNTY

Atlantic City district.—The E. T. Fisher Co. moved its dragline excavator and portable traction screening and sluicing plant from the property of the Timba-Bah Mining Co. on Rock Creek, where it had operated since 1933, to new ground comprising the Lemley and other placers farther up Rock Creek northwest of Atlantic City, where operations were carried on after June 1, 1938. Although its output of gold decreased from 1,415 fine ounces in 1937 to 406 ounces in 1938, the companv continued to be the principal producer of gold in the State. A dragline and washing plant operated on the Bonanza placer in Meadow Gulch from October 9 to October 31, 1938, recovered 45.86 crude ounces of placer gold averaging 0.910 fine in gold and 0.089 fine in silver. A lessee on placers in Strawberry and Poorman Gulches used a concentrating table and sluices to treat his gravel, and other placer miners in the Atlantic City district used hand sluices and pans.

Dump material from the Iron Duke property at Lewiston was trucked to the Gold Dollar mill of the Miners Delight Consolidated Mines Co. and treated by amalgamation. The B & H Gold Mining Co. shipped 147 tons of ore containing 96.09 ounces of gold and 197 ounces of silver from the Little Ellen No. 3 mine to smelters in Utah. The mine is opened by a vertical shaft 105 feet deep and 250 feet of drifts. The Christiana claim was under development by the Carya Mining & Development Co. from about March 15 to May 15, 1938. The underground workings completed when work was suspended because of lack of capital for development comprised a 100-foot shaft, a 160-foot tunnel, and a 200-foot raise. The company erected a 20-ton amalgamation-gravity concentration mill and made a test run that yielded gold-silver bullion containing 6.53 fine ounces of gold and 6 fine ounces of silver. Sample lots of ore shipped from two other properties and a clean-up of stamp battery boxes at the Carissa mine yielded some gold and silver.

Granite Mountains district.—The Emigrant Mining Co. did retimbering, shaft straightening, and 33 feet of development work from July to November 2, 1938, at the Red Boy property in sec. 36, T. 31 N., R. 93 W., sixth principal meridian.

PARK COUNTY

Sunlight district.—Four partners drove 20 feet of crosscut and 40 feet of drift on the Tip Top claim at the head of Galena Creek 18 miles southwest of Painter in 1938. They shipped 0.848 ton of ore assaying 0.01 ounce of gold and 39.90 ounces of silver to the ton, 0.7 percent copper, and 2.3 percent lead to the Bunker Hill smelter at Kellogg, Idaho.

SHERIDAN COUNTY

A placer miner sluicing on Rooster Creek in the Little Big Horn River area in northwestern Sheridan County recovered dust 0.961 fine in gold and 0.035 fine in silver in 1938.

TETON COUNTY

Frank J. Allen worked his Sterling placer, comprising three claims on Pacific Creek northeast of Moran, with a sluice box from July 1 to October 30, 1938, and produced 2.87 ounces of placer gold 0.917 fine.

SECONDARY METALS—NONFERROUS

By J. P. Dunlop [1]

SUMMARY OUTLINE

The total value of certain nonferrous metals, for which the quantity recovered from secondary sources is reported to the Bureau of Mines, was $137,915,800 in 1938—$101,215,000 less than in 1937; the total quantity decreased 299,810 short tons. The decline in total value was due partly to lower average prices for copper, zinc, tin, and lead, but the recovery of secondary copper, zinc, tin, aluminum, antimony, lead, and nickel all decreased.

Secondary metals of certain classes recovered in the United States, 1937–38

	1937		1938	
	Short tons	Value	Short tons	Value
Copper, including that in alloys other than brass	387,600	$93,799,200	252,700	$49,529,200
Brass scrap re-treated	206,400	41,677,000	153,100	24,668,400
Lead as metal	154,500	32,461,800	119,400	20,690,800
Lead in alloys	120,600		105,500	
Zinc as metal	[1] 64,540	[1] 9,839,700	42,270	4,672,300
Zinc in alloys other than brass	11,150		6,400	
Tin as metal	8,270	32,124,100	4,900	19,284,600
Tin in alloys and chemical compounds	22,030		18,710	
Aluminum as metal	29,360	23,773,000	16,700	15,326,000
Aluminum in alloys	33,200		22,100	
Antimony as metal and in alloys	12,340	3,776,000	8,500	2,099,500
Nickel as metal	917	1,680,000	850	1,645,000
Nickel in nonferrous alloys and salts	1,483		1,450	
	[1] 1,052,390	[1] 239,130,800	752,580	137,915,800

[1] Revised figures.

Scope of report.—"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, and drosses and are so called to distinguish them from metals derived directly from ores, which are termed "primary metals." The distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or waste material vary in purity and in adaptability to use in making certain products. The figures supplied by producers cover seven metals—secondary copper, lead, zinc, tin, aluminum, antimony,

[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.

and nickel—and supplement those in the various chapters of this volume on the primary metals. They are given to enable producers and consumers to form a more comprehensive idea of the quantities of metal available for consumption; in fact, they constitute an essential complement to the figures in the general reports on the primary metals and will become even more valuable in future.

The variety of waste material (especially metallic waste), its utilization, and much information on its collection and disposal appear in reports of this series for preceding years. These reports name the various trade papers that handle data on secondary metals and refer to many articles relating to secondary metals recovered.

Several papers [2] presented at the 1939 annual meeting of the National Association of Waste Material Dealers, Inc., dealt with the problems and needs of metal dealers and brokers in the scrap-metal industry.

SECONDARY METALS RECOVERED

The quantity of metals contained in numerous alloys made partly or wholly from secondary material cannot be ascertained definitely. The figures in the following tables and text, which are based upon results of the annual canvass, are approximate but constitute the only data available on an industry of growing importance.

Mints and refineries reported the recovery of 870,881 fine ounces of gold and 18,438,847 fine ounces of silver from waste or discarded material in 1938 compared with 1,040,227 ounces of gold and 23,564,986 ounces of silver in 1937. Jewelry and dental waste furnish the largest quantity of secondary gold [3] and silverware and photographic waste the largest quantity of secondary silver. Considerable gold and silver are recovered from plating solutions.[4]

No statistics collected by the Bureau of Mines show the quantity and value of old rails, pipe, machinery, and other equipment renovated for original use. Data issued by newspapers and trade publications indicate that an enormous quantity of such material is salvaged and reused. Scrap-metal collectors and dealers dispose of much of their stock to others than smelters and refineries. Foundries buy considerable quantities of good-grade copper, aluminum clippings, and tin clippings. Other customers purchase pipe, rails, stoves, radiators, boilers, and similar materials too valuable and salable to go to the melting pot.

In 1938 the price of heavy copper scrap ranged from 6.125 to 9.25 cents a pound, No. 1 composition scrap from 4.625 to 7.875 cents a pound, old zinc scrap from 1.88 to 3 cents a pound, cast-aluminum scrap from 4.625 to 9.375 cents a pound, and heavy lead scrap from 2.875 to 4.25 cents a pound.[5] This range of scrap-metal prices in 1938 was generally below that in 1937, and the quantities collected and sold were very much less, so that profits to dealers and smelters de-

[2] Earle, James S., Economic Aspects of Secondary Metals: Waste Trade Jour., Apr. 1, 1939, pp. 49, 51, 55, 57, 58.
Haskins, Charles M., Future of Waste Trade Industry: Waste Trade Jour., Apr. 1, 1939, pp. 39, 41–42.
Putney, R. A., Dealer and Refiner Have a Very Close Relationship in Scrap Metal Business: Waste Trade Jour., Apr. 1, 1939, pp. 53–54.
Skolnik, H. A., To Good Shippers Belong the Best Returns: Waste Trade Jour., Apr. 1, 1939, p. 105.
Wright, Thomas A., The Value of Scrap-Metal Analysis: Waste Trade Jour., Apr. 1, 1939, pp. 79, 81.

[3] Hoke, C. M., The Recovery of Silver, Gold, and Mercury from Precious Metal Amalgams: Metal Ind., January 1938, pp. 22–23.

[4] Savage, Frank K., Recovery of Gold and Silver from Plating Solutions: Metal Ind., April 1939, p. 160.

[5] The average daily and weekly quotations for many scrap metals and alloys can be found in the Waste Trade Journal, Waste Trade Review, Metal Industry, and American Metal Market.

creased. Prices were only fairly good in the first quarter, but there was a steady drop until the year's lows were reached in May and June. Prices then rose until they reached the high point of the year in October, then tapered off slightly. The last half of 1938 pulled the industry out of the doldrums and made the outlook for 1939 promising as to expanded business, with not much change in opening prices.

The sharp decline in the output of motorcars and in other metal-consuming industries in 1938 cut the quantity of new scrap as much as 25 to 35 percent for some metals and alloys. Die-casting and zincking fell off so that very much less zinc dross and skimmings were available for redistillation. Notwithstanding the lower prices, most of the urban scrap was shipped promptly; but the collections of old brass, batteries, and aluminum in rural districts were much less than in 1937, and shipments to secondary smelters and foundries lagged. There was little change in the number of secondary smelters. Only a few became insolvent, and few new plants were operated. The decline in the quantity of scrap and drosses treated was especially notable at some of the largest plants, for scrap dealers and brokers were not especially anxious to turn loose material bought at low prices.

Regular primary smelters treated 5,186 tons less lead scrap and 64,064 tons less copper scrap in 1938 than in 1937. The quantity of tin-plate scrap treated decreased about 15 percent. Secondary smelters handled much less brass and aluminum and alloys containing zinc and tin, secondary brass decreasing more than 53,000 tons.

A paper by James S. Earle, of the Bureau of Mines, was read at the meeting of the National Association of Waste Material Dealers. It is impossible, for lack of space, to reproduce all the article, but the following excerpts state some pertinent facts.

Secondary metal industry enjoys rapid growth.—Considering the enormous size and rapid growth of this reservoir of potential scrap it is not surprising that the secondary metal industry has enjoyed a phenominal advance. Because this reservoir is so broadly distributed throughout the country, your industry serves virtually every village and hamlet in the nation. There can be no doubt that as time goes on the reworking of scrap from this source will increase in importance, as undoubtedly the upward trend in the use of metals will continue for many years to come.

Another important source of raw material for the secondary metal industry is the metal scrap derived as a byproduct from manufacturing operations. This too has increased greatly in volume with the tremendous rise in industrial activity since the beginning of the century. Much of this type of scrap, however, bypasses the secondary metal trade owing to the fact that manufacturers are improving their facilities for treating their own scrap and to the growing tendency of producers of sheets, bars, and rods to take back scrap direct from their customers. Nevertheless, a substantial amount of this byproduct metal enters the scrap trade, although in comparison with metal reclaimed from use it is less important as a source of supply. The present state of development of the secondary metal industry, with its widespread activity, is thus due largely to the scrap available in the large stocks of metal in use in all parts of the country.

Before considering the various factors that control the flow of scrap from these major sources it will be helpful to define various economic classifications of scrap. Metal returning from the store of metal in use may be referred to as "old scrap" in contrast to the byproduct of industry designated "new scrap." Old scrap may be derived from capital goods, such as buildings and industrial machinery and equipment, or from consumer goods, such as automobiles, radios and cooking utensils. In general it may be stated that there is a larger reclamation of the metal consumed in capital goods than in consumer goods. It will be observed that the essential difference between old and new scrap is that the former represents metal that has been in use and is now returning because of obsolescence, whereas new scrap is essentially metal that has not yet reached the stage of final use. New scrap is not as widespread in origin as old scrap, as it is found only in industrial areas; old scrap is to be found wherever human beings exist.

Reclamation of old metals.—From the standpoint of the scrap metal dealer or refiner, it makes little difference whether the material he trades or uses is old or new scrap, but from the standpoint of conservation there is a significant difference. New scrap is merely refined metal in one stage of manufacture and the volume available at any given time depends on the rate of industrial production. It may be described as metal on the way to an ultimate use, and its flow occurs more or less automatically as an integral part of the manufacturing process. Old scrap, on the other hand, has reached the stage of ultimate use and, having served its purpose for whatever application it was designed, is now being reclaimed for another cycle of manufacture and use. As such, it relieves the necessity of extracting an equivalent amount of metal from the mines and thus prolongs the life of our limited metalliferous ore reserves. The services performed by your industry in collecting objects discarded by the population and returning them to use is perhaps the most real contribution to conservation actually being accomplished today.

From the viewpoint of the consumer, scrap may be classified further according to origin or ownership. "Plant scrap" or "home scrap" refers to material that originates in the same plant in which it is reworked. This type consists largely of new scrap resulting from current manufacturing operations, but occasionally some old scrap obtained from dismantling obsolete plant and equipment may be included. "Purchased scrap," as its name implies, is material that the consumer obtains from other sources. All scrap supplied by waste-material dealers would be designated as purchased scrap by the consumer. It contains both old and new scrap. It will be observed that plant scrap passes through the cycle from production to recovery without change of ownership whereas in the case of purchased scrap one or more changes in title may be involved.

Industry sensitive to changes.—The secondary metal industry in general is subject to the same economic factors that influence other productive enterprises. When industrial activity is at a high level prices are generally remunerative, and the volume of trade in scrap is quite satisfactory. Since new scrap is merely a by-product of current manufacturing operations, trade in this material naturally rises and falls with industrial activity. By and large, new scrap moves irrespective of price levels because, as a rule, manufacturers do not care to speculate on their scrap and many of them have very limited facilities for storing large quantities. Since the money return from scrap is a relatively small part of their total business, they prefer to keep the material moving away from their plants. At times of high prices, the incentive for collecting old scrap is greater and consequently at periods of high industrial activity there is a greater return of this material. Occasionally, however, the quantity of old scrap resulting from the demolition of capital goods may be higher in periods of low industrial activity because of the necessity for curtailing productive activities and the desire to maintain employees by providing other types of work such as dismantling obsolete plants.

The limits of scrap supply at any given time are determined by the cost of delivery to the consumer and by prices. When prices are down, the flow diminishes, and if prices are low enough, the movement ceases almost entirely because the material is not worth transporting to markets. The trade in scrap is greatly influenced by freight rates, the volume of industrial activity, the rate at which obsolescence and abandonment takes place, and stocks on hand at dealers yards and consumers plants. Some of these factors are amenable to precise evaluation but others, including some of great significance to the scrap metal trade, are little understood primarily because of a lack of basic statistical data.

Scrap's effect on metal prices.—The effect of scrap on metal prices appears to be a field requiring more study. When business is good, price levels for scrap appear to be determined by the supply and demand for virgin metals. But when prices reach unreasonably high levels unexpected supplies of scrap deluge the market and break prices. This has happened on more than one occasion. Likewise, when consumption is at a low level, scrap exerts a depressing effect, as was demonstrated in copper during the depression. Within the last few months we have witnessed the paradoxical situation of electrolytic copper selling on the open market at a considerable discount from the so-called official producers price, an event attributed largely to the influence of scrap.

The classification and sorting of scrap metal are tremendously important factors and ones in which there is room for improvement. Owing to the marked advance in the use of alloys the modern junk pile is a very complex affair. Proper classification of scrap not only pays dividends to the collector but from the national point of view permits better recovery of many valuable alloying elements now going to waste. Development of more simple and inexpensive methods of classification would be a distinct benefit to all concerned.

In the foregoing remarks an attempt has been made to outline briefly the fundamental soundness of the secondary metal industry and to point out some of the factors influencing the flow of scrap. We have seen that there is need for a broader understanding of the basic economics of this industry. We have seen, also, that the reservoir of metal in use is a national asset equivalent to the crude metallic minerals contained in the earth's crust. It is not surprising, therefore, that the Government agencies chiefly concerned with the conservation of mineral raw materials have been interested in the recovery of secondary metals for many years.

Secondary copper and brass.—Copper produced in 1938 by smelters that handle scrap metals and drosses exclusively included 99,858 tons of pig copper (part of which was electrolytically refined), 107,100 tons of copper in remelted brass, and 60,300 tons in alloys other than brass. These figures indicate decreases of 29,136 tons of pig copper, 37,400 tons of copper in brass, and 41,700 tons in copper alloys other than brass. Regular copper smelters produced 64,064 tons less secondary copper in 1938 than in 1937.

The total value of secondary copper as metal and in brass and other alloys computed at 9.8 cents a pound (the average price in 1938 of all merchantable grades of new metal) was $70,520,800, about $58,247,400 less than in 1937.

Scrap-copper exports increased 897 tons and scrap-brass exports decreased 2,563 tons in 1938 compared with 1937.

Secondary copper recovered in the United States, 1937–38, and imports and exports of brass and copper scrap, in short tons

	1937	1938		1937	1938
Copper as metal	[1]285,600	[1]192,400	Total secondary copper (including copper content of brass scrap):		
Copper in alloys other than brass	102,000	60,300	From new scrap	123,200	92,500
	387,600	252,700	From old scrap	408,900	267,300
				532,100	359,800
Copper from new scrap (not including brass)	61,600	40,000			
Copper from old scrap (not including brass)	326,000	212,700	As metal	285,600	192,400
			In brass and other alloys	246,500	167,400
	387,600	252,700		532,100	359,800
Brass scrap remelted:			Brass scrap imported	(2)	--------
New clean scrap	88,000	75,000	Scrap copper imported	41	(3)
Old scrap	118,400	78,100	Brass scrap exported	18,551	15,988
			Scrap copper exported	20,914	21,811
	206,400	153,100			
Copper content of brass scrap (averaging 70 percent copper):					
New scrap	61,600	52,500			
Old scrap	82,900	54,600			
	144,500	107,100			

[1] Of these totals secondary copper reported by smelters and refiners that treat mainly primary metal comprised 156,606 tons in 1937 and 92,542 tons in 1938.
[2] 611 pounds, gross weight.
[3] 190 pounds, gross weight.

The terms "new brass scrap" and "new copper scrap," as applied in the preceding table, refer to the scrap accumulated in fabricating products; "old scrap" is the metal that was made into products and after service has been discarded and returned to be remelted or refined for further use. Few junkmen, dealers, or smelters keep any statistics of "old scrap" and "new scrap." Most of the new scrap is clippings, grindings, and defective articles made in the ordinary operations in fabricating goods, some of which is reused at the plant and the remainder sold. All foundries and rolling mills (many of which purchase scrap metals) are advised in the Bureau of Mines questionnaire to exclude all scrap made and used in their own plants and to give data on purchased scrap alone. Those that purchase only "new scrap" of certain grades and assay can give correct data; the others usually can make some distinction between "new" and "old" scrap. Secondary smelters usually cannot give exact figures but occasionally can estimate the proportion of "new" scrap metal treated. The figures in the preceding table are the best obtainable.

Reports for 1938 show that railroads reused the following quantities of scrap metals at their shops and foundries: 6,730 tons of brass; 592 tons of copper; 9,071 tons of copper in alloys other than brass; 990 tons of tin in babbitt, solder, and bronze; and 4,400 tons of lead in various alloys.

Secondary lead.—The output of secondary lead in 1938 equaled 58.6 percent of the total production of refined primary lead from domestic and foreign sources in the United States compared with 59 percent in 1937. Much recovered lead is derived from discarded batteries, pipe, sheet, and lead-covered cable; other sources are type metal, solder, babbitt, and shot.

Secondary lead recovered by smelters whose product is mainly primary metal decreased 5,186 tons in 1938. The output of pig lead by secondary smelters decreased about 29,900 tons and that of lead in scrap alloys 10,879 tons.

Owing to the greatly decreased output of motor cars and the smaller number of scrapped cars in 1938 the quantity of old batteries smelted was much less than in 1937. Apparently urban dealers collected fewer batteries but did not hold them for higher prices. Some stocks of batteries are held in rural areas, but the total quantity is not large. Recovery of battery plates is expected to increase in 1939 because purchases of new motor cars are larger. A number of secondary smelters treating old batteries and other lead alloys now recover much of the lead as good-grade pig lead. The residues and drosses containing antimony are then used in making hard lead containing various percentages of antimony. Some of the problems in handling old batteries are stated in an article by Neuman.[6]

Secondary lead recovered in the United States, 1937–38, in short tons

	1937	1938
Secondary lead recovered by smelters that treat mainly ore	29,986	24,800
Secondary lead recovered by smelters that treat only scrap and drosses	124,514	94,600
	154,500	119,400
Secondary lead recovered in remelted alloys:		
Estimated secondary lead content of antimonial lead produced at regular lead smelters [1]	15,391	11,170
Lead content of drosses and scrap alloys treated at secondary smelters	105,209	94,330
	120,600	105,500
Total secondary lead recovered	275,100	224,900

[1] Antimonial lead produced at primary smelters totaled 27,534 tons containing approximately 7,833 tons of primary domestic lead, 1,721 tons of primary foreign lead, 1,636 tons of primary domestic antimony, 90 tons of primary foreign antimony, 15,391 tons of secondary lead, and 853 tons of secondary antimony in 1937 compared with 24,123 tons containing approximately 6,759 tons of primary domestic lead, 3,385 tons of primary foreign lead, 2,080 tons of primary domestic and foreign antimony, and 11,170 tons of secondary lead, and 729 tons of secondary antimony in 1938.

[6] Neuman, E. A., Journey of Battery Plates from Dealer to Consumer: Waste Trade Jour., Mar. 27, 1937, pp. 89, 94.

Refined primary lead produced in the United States, 1937–38, in short tons

	1937	1938
From domestic ore	443,142	331,964
From foreign ore and base bullion	24,175	51,705

The American Bureau of Metal Statistics estimates that each of the 14,500,000 automobile batteries made in 1938 contained an average of 21.6 pounds of lead and antimony, the same as in 1937. The average in each battery in 1936 was 23.7 pounds and in 1933, 25.1 pounds.

The sampling of battery plates is much more difficult than the assaying, owing to the moisture in the rubber and separators.

Numerous old batteries are smelted on toll by custom smelters. The smelters also purchase batteries at a price based on that of pig lead at St. Louis; the antimony content is, however, paid for at the price of lead, although the price of antimony in 1938 was about three times that of lead.

It is generally considered that too high prices have been and are being paid to holders of old batteries, that dealers pay too much for them, and in turn that the smelters' and refiners' profit is normally too small. Frequently the recovery of the antimony alone yields any profit. A humorously expressed argument for concerted action to remedy this condition was given in a paper [7] read at the meeting of the National Association of Waste Material Dealers on March 21–22, 1939. Old batteries are a problem to dealers and smelters as well as to the sellers of primary lead because they are scrapped and return to stocks in such a comparatively short time. Another article presented at the same meeting stated the factors other than the quoted prices of primary lead that determined the prices offered for battery lead.[8]

Admittedly there are many factors, which are stated, but the main one is that the selling price depends primarily on the price and activity of antimonial lead and not on the price of and demand for primary lead.

Secondary zinc.—Secondary zinc recovered as pig metal and in alloys (including brass) decreased 40,220 short tons. The zinc content of brass remelted was 13,200 tons less in 1938 than in 1937. The total recovery of secondary zinc (including that in brass) equaled 20 percent of the total output of primary slab zinc in the United States (446,341 tons) in 1938. In addition, large quantities of the zinc dust, zinc chloride, and other compounds were made from zinc drosses and residues.

[7] Friedman, Benjamin, Give Battery Lead a Break: Waste Trade Jour., Apr. 1, 1939, p. 63.
[8] Neuman, E. A., Some Misconceptions of Battery Lead Scrap Prices Paid by Smelters: Waste Trade Jour., Apr. 1, 1939, pp. 73–74.

Secondary zinc [1] recovered in the United States, 1937–38, and products made from zinc dross, skimmings, and ashes, in short tons

	1937	1938
Secondary zinc recovered by redistillation	51,554	31,613
Secondary zinc recovered by sweating, remelting, etc	[2] 12,986	10,657
Total zinc recovered unalloyed	[2] 64,540	42,270
Zinc recovered in alloys other than brass	11,150	6,400
Zinc recovered in brass (estimated)	51,600	38,400
Zinc dust made from zinc dross	15,242	11,609
Zinc concentrates and ore exported; Zinc dross exported	314	135
Lithopone made from zinc skimmings and ashes	66,064	58,563
Secondary zinc content of lithopone	13,040	11,262
Zinc chloride made from zinc skimmings, ashes, etc	(3)	(3)
Zinc content of zinc chloride made from zinc skimmings, etc	(3)	(3)
Zinc content of zinc sulphate made from zinc skimmings, ashes, etc	1,735	1,395
Zinc oxide produced from zinc scrap and drosses	10,349	9,357

[1] Figures do not include scrap and dross used for lithopone or chloride. The use for zinc chloride, especially, is large.
[2] Revised figures.
[3] Data not available.

Zinc recovered by redistillation decreased from 51,554 tons in 1937 to 31,613 in 1938. Of the 1938 total, 14,003 tons (a decrease of 10,128 tons) were recovered at primary smelters from zinc drosses and 17,610 (a decrease of 9,813 tons) at six secondary plants that used large graphite retorts, two plants that used clay retorts, and one that used both, which treated only drosses and residues in 1938. The large decrease in the recoveries of redistilled zinc was the normal result of the greatly reduced quantity of zinc used in zincking and in die casting. It is estimated that 40 to 45 percent less zinc was used in die casting in 1938 than in 1937. Much of the decrease was due to the sharp decline in the number of motorcars made in 1938. The seven active smelters using large graphite retorts in 1938 were:

W. J. Bullock, Fairfield, Ala.
Federated Metals Corporation, Trenton, N. J.
General Smelting Co., Philadelphia, Pa.
Nassau Smelting & Refining Co., Tottenville, N. Y.
Pacific Smelting Inc., Ltd., Torrance, Calif.
Superior Zinc Corporation, Bristol, Pa.
Wheeling Steel Corporation, Wheeling, W. Va.

Of the total output of 122,297 tons of lithopone in 1938, 58,563 tons containing 11,262 tons of zinc were made from zinc skimmings and ashes.

The American Bureau of Metal Statistics estimates that 198,000 tons of zinc (54,000 tons less than in 1937) were used in 1938 in zincking (galvanizing) sheets, forms, tubes, wire, and other products.

Secondary tin.—Secondary tin recovered amounted to 23,610 tons valued at $19,284,648 in 1938 compared with 30,300 tons valued at $32,124,100 in 1937. The total value assigned is based on the yearly average price (40.84 cents in 1938 and 53.01 in 1937) given by the American Metal Market for 99-percent metal, prompt delivery at New York.

Figures for recovery of pig tin for earlier years are not comparable with 1936, 1937, and 1938, as all tin recovered at tin-plate plants by operators by treating tin scruff was eliminated beginning in 1936. This tin is recovered in the ordinary course of operations at nearly all plants, and its elimination decreased 1936, 1937, and 1938 totals about 2,000 tons. The tin recovered in alloys and chemical compounds decreased 3,320 short tons in 1938. Secondary tin recovered in 1938 was equivalent to about 42.4 percent of the tin imported into the United States as pig metal in 1938.

According to reports to the Bureau of Mines, 1,510,502 long tons of tin plate and terneplate were made in 1938. It is estimated that about 25,567 long tons of tin were used in these products and that 3,921 short (3,502 long) tons of tin were recovered from tin-plate clippings and old coated containers.

Owing to the relatively high value of tin, it is important that the degree of accuracy be high in obtaining representative samples of shipments of tin dross and in analyzing them later.[9]

Many earlier chapters of this series contain data on plants and processes followed, and a complete history of the different methods of detinning has been published by Mantell.[10]

The rules of procedure governing issuance of licenses for exportation of tin-plate scrap during 1939 were released by the Department of State on December 16, 1938. Allotments will be based on each individual producer's request therefor, with the provision that no allotment of more than 25 long tons shall exceed 20 percent of the tin-plate scrap produced by him during the calendar year 1937. No allotment to any producer shall exceed 2,000 tons. Export quotas for 1938 were based on 25 percent of 1937 production, and a total of 15,000 tons was assigned. In all, 187 licenses actually were issued authorizing the exportation of 13,237 tons of tin-plate scrap valued at $226,728.47. All licenses issued during 1938 named Japan as the country of destination.

H. R. 5840 (76th Congress) proposes to extend the licensing feature of the Faddis-Barbour Law to "other scrap, drosses, or residues, the tin content of which is in excess of 10 per centum in which the copper content does not exceed the tin content." This bill passed the House of Representatives on May 1, 1939. Details of other Government action affecting tin and a discussion of the national defense aspects of tin are given in the Tin chapter of this volume.

Notwithstanding the fact that the price of tin decreased about 12 cents a pound in 1938 some old tin-coated containers were treated at detinning plants, although the quantity decreased about 1,800 long tons. Many more old cans could be treated at existing plants, but collections are restricted to areas adjacent to the plants because of the cost of collecting, shipping, and cleaning such bulky material. A large quantity of old cans is disintegrated at Los Angeles and used at copper mines in Utah and other States, but no attempt is made to recover the tin coating.

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[9] Kasey, J. B., A Suggested Method for Preparing Deliquescent Tin Dross Samples: Metal Ind., September 1936, p. 338.

[10] Mantell, C. L., Scrap Detinning Affords Big Outlet for Chlorine: Chem. and Met. Eng., 1926, pp. 477–479.

Secondary tin recovered in the United States, 1937–38

	1937	1938
Tin recovered as pig tin short tons	8,270	4,900
Tin recovered in alloys and chemical compounds do	22,030	18,710
	30,300	23,610
Clean tin-plate scrap treated at detinning plants long tons	247,723	209,474
Metallic tin recovered at detinning plants pounds	5,700,942	4,982,836
Tin content of tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants pounds	3,378,760	2,778,370
Total tin recovered at detinning plants do	9,079,702	7,761,206
Tin tetrachloride, tin bichloride, tin crystals, and tin oxide made at detinning plants pounds	6,956,685	5,514,072
Average quantity of tin recovered per long ton of clean tin-plate scrap do	36.7	37.05

Tin (metal) and tin concentrates (tin content) imported into the United States, 1936–38, in short tons

	1936	1937	1938
Tin imported as metal	85,152	98,689	55,663
Tin concentrates (tin content) imported	200	169	(1)

1 Less than 1 ton.

The quantity of tin-plate clippings treated at detinning plants decreased about 28,250 long tons in 1938, and the average cost of such clippings delivered at plants decreased from $19.38 a long ton in 1937 to $11.42 in 1938. These clippings were treated at plants of the Vulcan Detinning Co. at Sewaren, N. J., Neville Island, Pa., and Streator, Ill.; of the Johnston & Jennings Co. at Cleveland, Ohio; and of the Metal & Thermit Co., at South San Francisco, Calif., East Chicago, Ind., and Chrome, N. J.

Imports of tin-plate scrap in 1938 totaled 10,444 long tons valued at $81,685 compared with 12,916 tons valued at $179,459 in 1937. Of these amounts, Canada supplied 11,881 tons valued at $170,925 in 1937 and 10,682 tons valued at $74,658 in 1938.

Exports of tin-plate scrap decreased from 14,126 long tons valued at $246,770 in 1937 to 12,495 tons valued at $227,874 in 1938. Japan took all the exports in 1937 and 1938. This material would yield Japanese detinners about 35 pounds of tin per long ton.

Exports of waste tin plate decreased from 26,259 long tons valued at $2,022,955 in 1937 to 7,255 tons valued at $474,689 in 1938, of which Japan took about 71 percent in 1937 and about 16 percent in 1938.

The tin reported recovered in alloys and compounds in 1938 included the tin content of products made from clean tin-plate scrap. Most of the tin recovered at the plants listed was in sodium stannate, tin crystals, tin tetrachloride, and tin oxide.

The total recovery of tin as metal or in compounds from clean tin-plate scrap in 1938 was 3,881 short tons, whereas it is estimated that makers of tin plate and terneplate consumed nearly 24,552 long tons of tin. Some old tin-coated containers treated at Chrome, N. J., yielded 27.3 pounds of tin per long ton.

Secondary aluminum.—The recovery of secondary aluminum, including that in alloys, totaled 38,800 short tons valued at $15,326,000 compared with 62,560 tons valued at $23,773,000 in 1937. The value in 1937 was computed at 19 cents a pound and in 1938 at 19.75 cents a pound.

The value of primary aluminum produced in the United States increased from $55,609,000 in 1937 to $56,659,000 in 1938.

Secondary aluminum recovered in the United States, 1937–38, in short tons

	1937	1938
Secondary aluminum recovered unalloyed	29,360	16,700
Aluminum recovered in alloys (mainly No. 12)	33,200	22,100
	62,560	38,800

Primary aluminum produced in the United States and imported and exported, 1937–38, in pounds

	1937	1938
Primary aluminum produced in the United States	292,681,000	286,882,000
Aluminum (crude and semicrude) imported for consumption	45,178,069	17,740,281
Aluminum (crude and semicrude) exported	5,383,516	12,618,078

Prices for scrap cast aluminum ranged from 9.37 cents a pound in January to as low as 4.62 cents in June. New aluminum clippings had a spread of 2.5 cents a pound in 1938, ranging from 14 cents in January to a low of 11.5 cents in June. Demand was sagging and prices were low from April to August. Scrap-aluminum clippings remelted in the ordinary course of shop practice were excluded from 1938 recoveries wherever possible. About 400 tons of aluminum clippings were purchased by makers of metallic powders in 1938. These pure clippings are the most suitable material for this purpose, but frequently it is difficult to purchase them, for a large quantity is remelted and rolled into sheet aluminum.

A progress report of the Aluminum Research Institute by its secretary, R. D. T. Hollowell,[11] gives the following interesting information, which is abstracted from that report:

Just as long as satisfactory secondary aluminum is produced at prices that compare favorably with those paid for primary metal it is unprofitable for foundrymen to use virgin metal if secondary metal will produce equally good results.

Prior to about 1916 the chemical composition of secondary aluminum ingot was governed almost entirely by the chemical composition of the scrap from which it was made. Pure clippings and sheet scrap (which in those days was pure) were commonly added to reduce the percentage of impurities but the impurities were not eliminated. Fluxing was practiced in the heating of the dross so that it could be more easily separated from the bath of molten metal. Prior to 1924 the scrap aluminum that came on the market was chiefly No. 12 casting alloy, which contained 92 percent aluminum and 8 percent copper. Aluminum sheet in those days was about 99 percent pure.

New aluminum alloys were soon developed. Manganese was one of the early elements to be added to aluminum. Then came silicon and more complex alloys with magnesium. Today, we find aluminum alloys containing one or more of the following alloying elements: Nickel, manganese, silicon, lead, tin, titanium, chromium, and magnesium. Beryllium, calcium, lithium, and sodium were also introduced into aluminum alloys. Of late, the increased use of magnesium castings has further complicated the problem due to the fact that it is difficult to distinguish magnesium from aluminum castings by appearance only. Today, certain

[11] Hollowell, R. D. T., Secondary Aluminum and Its Alloys: Nat. Waste Rev., April 1939, pp. 15-17.

grades of nonmagnetic stainless steels stray into the aluminum scrap and make sorting still more difficult.

In order to keep pace with the introduction of all these different alloys, the successful "remelter" was forced to develop into a refiner. In order to produce secondary metal with known properties and definite analysis, he found it necessary to operate chemical and metallurgical laboratories.

Not only does the laboratory of an up-to-date aluminum refiner obtain exact chemical analysis of the scrap and finished ingot, but it also checks the finished metal for tensile strength, elongation, hardness, impact resistance, and other physical properties.

The modern smelter maintains an experimental foundry in which the fluidity and shrinkage of the ingot are determined before shipping to a customer. Intricate designs are poured to check foundry quality. Castings are poured at high temperatures to determine freedom from stain or discoloration.

The results obtained from these more or less routine tests taught the modern smelter that, in order to obtain uniformity, he must of necessity remove some of the harmful impurities—in other words, he must truly refine the metal. It is with a great deal of pride that the Aluminum Research Institute now reports that its members remove not only oxides, nonmetallic inclusions, and gases, but also free the aluminum from certain alloying elements which interfere with foundry properties and which mar the appearance of the finished castings.

This progress in refining practice is due in no small measure to the maintenance by the leading refiners of true research laboratories—laboratories quite divorced from routine analysis and plant control. The equipment in some of these laboratories compares favorably with the metallurgical equipment maintained by manufacturers in other important fields.

There was a time when consumers thought that secondary aluminum was distinctly inferior to virgin metal, and that, consequently, it could not be used for their more exact requirements. Today, secondary aluminum manufactured by a responsible smelter who maintains complete laboratory service, can be satisfactorily used for almost any purpose where primary metal is regularly employed. This does not mean that secondary metal, irrespective of composition and quality, can be substituted for good grades of primary metal. It does mean that secondary metal of the required composition, properly made and refined, is metallurgically equivalent to primary aluminum in every respect.

The complexity of the aluminum scrap that is coming on the market today is the reason why most up-to-date foundries have either discontinued entirely, or soon will be confronted with the necessity of discontinuing, the use of scrap aluminum. For the last year or two, it has been almost impossible for the foundryman to buy pure aluminum in the form of clippings. Practically all clippings are comingled with alloy clippings, such as duraluminum and others. Cast aluminum is still being purchased and used as scrap by some of the smaller foundries. The increased number of casting alloys now used makes it more and more difficult for the average foundry to duplicate the refining process followed by the modern secondary aluminum manufacturer, unless the foundry is able to buy in tremendous quantities and put in its own control laboratories for checking raw materials and finished products.

Ever since its organization, the Aluminum Research Institute has endeavored to standardize the alloys most commonly used by aluminum foundries. In cooperation with the National Association of Waste Material Dealers, the Institute published standard purchase specifications for all grades of aluminum scrap. These have been accepted as standard by the entire aluminum industry.

One of the greatest services the Institute has rendered to the industry lies in the field of chemical analysis. When the industry was in the purely "remelt" stage, little attention was paid to chemical analysis. Later, however, the necessity for laboratory control led to the discovery that the analysis of the same alloy made by different laboratories did not check. When, in the case of a dispute, an outside chemist was called in, his analysis was often quite different from all the others. The result was frequent disputes, losses through rejections of material, and unsatisfactory dealings between the smelter and his customers.

At one of the early meetings of the Institute, it was decided to prepare a standard check sample to see how our own laboratories checked with each other. When member laboratories reported widely varying results, something had to be done. The Aluminum Company of America had previously prepared standard methods of analysis, but these methods, while well fitted to alloys made of new metals of high purity, were not always satisfactory for analyzing the more complex and comingled secondary alloys.

The Institute, after several years of painstaking work, prepared standard methods of analysis for secondary aluminum. In 1932 these methods were published and widely distributed. By their use, check results were obtained. The chemists committee of the Institute, responsible for these methods, has continued its work. Many carefully prepared samples have been distributed for check and standardization purposes. Many new methods have been tried out. Many important changes have been made in the original analytical methods. New improved methods are now being prepared for publication and will soon be ready for distribution to those interested.

The Aluminum Research Institute is preparing and plans to have available about July 1 standard samples of secondary aluminum of known chemical analysis. These samples will be sold at cost to any laboratory interested in aluminum and may be used for check purposes.

The Aluminum Research Institute has taken the lead in the last few years in developing specifications for certain grades of secondary aluminum alloys. These specifications are rigidly adhered to by members of the Aluminum Research Institute, and they are in a position to furnish alloys to these specifications which will, when properly cast, show the physical properties indicated.

We wish to express our appreciation of the time you have so courteously extended to us. We pledge to you in the name of our Association members our unceasing efforts to continue to improve our product and to cooperate with you in the solution of your problems.

Secondary antimony.—The principal materials refined or remelted that contained antimony as an alloy were hard-lead drosses, babbitt, bearing metal, battery plates, pewter, and type metal. The antimony used in the pigment, paint, and ceramic industries is so dissipated that no secondary recoveries can be made, but a large proportion of the production of metal containing antimony returns in a few months or years for refining and reuse. Antimony in type metal and in bearings returns very rapidly for refining. This large return of scrap in type and bearing metals normally goes to the makers of type and bearing alloys, which restricts the market for antimonial lead. It may take several years for antimony in battery plates to return as scrap, but probably 80 to 85 percent is certain to come back for reuse in less than 3 years.

The production of secondary antimony in the United States, most of which was recovered in alloys, decreased in 1938. The average price for ordinary brands (Chinese grade) of antimony, as stated by the American Metal Market, was 12.35 cents a pound in 1938 compared with 15.35 cents in 1937. Smelters that ordinarily use primary ores, concentrates, or metal reported 2,080 tons of primary antimony and 729 tons of secondary antimony as contained in 24,123 tons of antimonial lead. The recovery of secondary antimony by secondary smelters decreased 3,716 tons.

Imports of antimony in ore, as metal, or in oxide were 7,116 tons less than in 1937.

Secondary antimony recovered in and antimony imported into and exported from the United States, 1937–38, in short tons

	1937	1938
Secondary antimony in antimonial lead scrap smelted at regular smelters	853	729
Secondary antimony recovered at secondary smelters	11,487	7,771
	12,340	8,500
Antimony imported in ore, as metal, or as oxide or salts	16,769	9,653
Foreign antimony exported	437	711

Secondary nickel.—The nickel reported as recovered from secondary sources includes nickel in Monel metal (the natural alloy) but not that in ferrous alloys. The practice of using small quantities of nickel in iron and steel as well as in brasses and bronzes expanded greatly in both 1937 and 1938. Activity was much less at foundries in 1938. A large part of their products contained some nickel.[12]

Nickel often was substituted for tin to reduce costs in certain alloys requiring tensile strength and ductility.

Most of the secondary nickel recovered in 1938 came from scrap—nickel anodes, nickel-silver, copper-nickel alloys, and Monel metal. Exports of nickel scrap and scrap alloys containing nickel decreased. It is impossible to give the nickel content of all the exports of such nickel-bearing scrap, but the total nickel content reported by exporters who submitted data to the Bureau of Mines was 991 tons in 1937 and 870 in 1938.

Although the trend toward the use of nickel in iron and steel alloys increased in 1938, the secondary nickel recovered in ferrous alloys was undoubtedly less in 1938 than in 1937. Robert C. Stanley, president of the International Nickel Co., Ltd., estimates that about 42 percent of all nickel consumed in the United States is used in nickel iron and steel, mainly in motor cars, railway equipment, heat-resistant alloys, and machinery. Few of these industries expanded in 1938.

Probably more secondary nickel is recovered from ferrous than from nonferrous alloys, but no figures are available. Certain alloys give uninformed dealers trouble.[13]

Scrap iron and steel dealers frequently are careless in handling alloy ferrous scrap, and certain discarded equipment and automobile scrap that contain nickel are thrown in with the regular steel scrap instead of being kept separate and advantage taken of their greater value.[14]

Secondary nickel recovered in the United States, 1937–38, in short tons

	1937	1938
Nickel recovered as metal	917	850
Nickel recovered in nonferrous alloys and salts	1,483	1,450
	2,400	2,300

Primary nickel produced in the United States and imported and exported, 1937–38 in short tons

	1937	1938
Nickel produced as a byproduct from the electrolytic refining of copper at domestic refineries	219	416
Nickel imported for consumption in the United States as nickel or in nickel ores and matte, oxide, and alloys	54,438	29,545
Nickel, Monel metal, and other alloys exported	3,817	5,921

[12] Curry, D. M. (International Nickel Co.), Nickel in Brass-Foundry Practice: Metal Ind., New York, 1936, pp. 330, 332.
[13] Edelstein, Joel, Nickel Alloys in Scrap Metals: Waste Trade Jour., March 28, 1936, pp. 83, 87; Trials of a Nickel Specialist: Waste Trade Jour., March 26, 1938, p. 139.
[14] Wilenchik, I. W., Profits in Nickel Alloys: Waste Trade Jour., Mar. 27, 1937, p. 147.

CLASSIFICATION OF OLD METALS

The classification of old metals drawn up by the Metals Division of the National Association of Waste Material Dealers, Inc., Times Building, New York, N. Y., and changed from time to time as desirable, is the standard of both dealers and manufacturers in the United States. The latest classification (Circ. M), effective March 16, 1932, was given in the Secondary Metals chapter, Minerals Yearbook, 1936. No immediate changes in this classification are contemplated.

There is a growing demand for scrap-metal specialties (not specifically covered by the classification), such as nickel alloys, German silver, Monel metal, cadmium, and molybdenum. Difficulties have arisen in making shipments to buyers' specifications, and with the object of eliminating some of the trouble the Waste Trade Journal published classifications used by one of its advertisers. A list of these was given on pages 338 and 339 of the Secondary Metals chapter in Mineral Resources of the United States, 1930, part I.

SCRAP IRON AND STEEL

By James S. Earle

SUMMARY OUTLINE

In presenting this new chapter of Minerals Yearbook attention is directed to the annual surveys on the consumption of ferrous scrap and pig iron in the United States beginning with 1935. The results of the 1935, 1936, and 1937 surveys have been published as separate reports.[1] In the canvass of consumers of ferrous scrap and pig iron, data are obtained only on scrap used in remelting processes. Material salvaged and reused in its original condition, or reshaped, is thus omitted from the survey.

Scrap has been divided into materials described as "home" and "purchased." The former includes scrap resulting from manufacturing processes, as well as old material produced at the plant reporting. As the name implies, the latter consists not only of scrap purchased from outside sources but also of scrap transferred from other plants under the same control and scrap received under exchange contracts or conversion agreements. No attempt has been made to differentiate between "old" and "new" scrap because ferrous-scrap accumulations contain both old and new material which is difficult to segregate statistically.

Although some concerns may utilize high proportions of old plant scrap for a limited period, in general the material included under the heading of home scrap largely represents recycled or run-around scrap and may be considered by many as merely rotating working stock rather than as actual consumption. However, this scrap constitutes a definite part of the furnace charges and must be included to obtain a complete picture of raw-material consumption in steel manufacture.

[1] Lund, R. J., and Davis, H. W., Consumption of Ferrous Scrap and Pig Iron in the United States in 1935: Bureau of Mines Rept. of Investigations 3329, 1936, 16 pp.
Ridgway, R. H., Davis, H. W., and Trought, M. E., Consumption of Ferrous Scrap and Pig Iron in the United States in 1936: Bureau of Mines Rept. of Investigations 3366, 1937, 21 pp.; Consumption of Ferrous Scrap and Pig Iron in the United States in 1937: Bureau of Mines Rept. of Investigations 3420, 1938, 22 pp.

This is particularly applicable as long as ingot production (which includes a large part of this recycled scrap) remains the yardstick for measuring activity in the steel industry.

GENERAL SUMMARY

Consumption of scrap iron and scrap steel in the United States decreased sharply in 1938 from that in 1937 owing to the low rate of industrial production. Prices received little support from the domestic market during the first part of 1938 and, as foreign demand weakened, reached the low point of the year in June. At that time foreign purchasers again entered the market, but prices did not react sharply until the latter part of July following improvements in the domestic market occasioned by the increasing rate of industrial production which began early in that month. The higher price levels reached early in the last quarter were maintained until the close of the year.

Exports of ferrous scrap from the United States dropped 27 percent in 1938 compared with 1937. However, the tonnage and value of the exports in 1938 were second only to those in 1937, when record shipments were made. Consignments of scrap from the United States to Japan, the United Kingdom, Poland, and Canada were curtailed sharply in 1938, but those to Italy, Germany, and the Netherlands showed a marked gain.

The question of the embargo on exports of scrap iron and scrap steel (S. 2025, 75th Cong.), which was raised in 1937 when prices and world production of steel were skyrocketing, received little support in 1938, with the result that the bill was allowed to die in committee. However, similar bills were introduced in the Seventy-sixth Congress early in 1939.

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 1938 was equivalent to 132 percent of the iron content of all domestic and foreign iron and manganiferous iron ores used in blast furnaces, and purchased scrap alone equaled 62 percent of the iron content of the ores; in 1937 the comparable percentages were 119 and 57.

The total consumption of ferrous scrap and pig iron in 1938 decreased 45 percent from 1937, as shown in the following table. Of the 39,849,283 gross tons used, 31,350,025 tons were charged to steel-making furnaces and 8,499,258 tons to iron furnaces. In making the average ton of steel in 1938 more scrap and less pig iron were used than in 1937; a decline in the relative use of purchased scrap was more than offset by an increase in the relative use of home scrap. In iron furnaces the relative use of purchased scrap increased, that of home scrap changed little, and that of pig iron decreased.

Summary statistics of ferrous scrap and pig iron in the United States, 1937–38

	1937	1938	Decrease in 1938
Ferrous scrap and pig iron charged to—	*Gross tons*	*Gross tons*	*Percent*
Steel furnaces: [1]			
Home scrap	15,006,136	8,521,258	43
Purchased scrap	13,364,226	7,137,455	47
Pig iron	28,851,266	15,691,312	46
	57,221,628	31,350,025	45
Iron furnaces: [2]			
Home scrap	4,864,897	2,800,083	42
Purchased scrap	4,771,013	2,886,138	40
Pig iron	5,205,261	2,813,037	46
	14,841,171	8,499,258	43
All furnaces:			
Home scrap	19,871,033	11,321,341	43
Purchased scrap	18,135,239	10,023,593	45
Pig iron	34,056,527	18,504,349	46
	72,062,799	39,849,283	45
Ferrous scrap:			
Consumption	38,006,272	21,344,934	44
Exports:			
Iron and steel	4,048,102	2,974,391	27
Tin plate, waste-waste, circles, strips, cobbles, etc	53,447	24,216	55
Average prices per gross ton:			
Scrap:			
No. 1 heavy melting, Pittsburgh	$18.86	$14.02	26
No. 1 cast cupola	18.50	15.13	18
For export	18.91	15.11	20
Pig iron, f. o. b. Valley furnaces:			
Basic	22.99	21.70	6
No. 2 foundry	23.49	22.20	5

[1] Includes open-hearth, bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.

The following table shows that scrap constitutes by far the greater part of the raw materials used in the Southwestern, Pacific Coast, and New England districts. These regions, however, used less than 6 percent of the total scrap consumed in 1938. Except for the Southeastern district, proportionately more scrap was used in all areas in 1938 than in 1937, although most of the increases were relatively small. Apparently, lower prices for scrap explained much of the increase in 1938, especially in outlying areas.

Total ferrous scrap and pig iron consumed in the United States and percentage of total derived from home scrap, purchased scrap, and pig iron, 1937–38, by districts

District	1937					1938				
	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	875,185	26.7	45.9	72.6	27.4	479,464	26.1	46.7	72.8	27.2
Middle Atlantic	24,684,871	26.4	22.2	48.6	51.4	12,025,365	28.8	22.1	50.9	49.1
Southeastern	8,600,595	25.1	22.6	47.7	52.3	6,238,315	25.3	19.9	45.2	54.8
Southwestern	223,468	23.2	66.1	89.3	10.7	138,187	25.5	71.3	96.8	3.2
North Central	35,733,265	29.3	25.7	55.0	45.0	19,783,190	29.4	26.0	55.4	44.6
Rocky Mountain	856,094	23.3	33.2	56.5	43.5	372,256	24.4	38.9	63.3	36.7
Pacific Coast	1,089,321	23.1	62.3	85.4	14.6	812,506	24.5	64.0	88.5	11.5
	72,062,799	27.6	25.1	52.7	47.3	39,849,283	28.4	25.2	53.6	46.4

Figure 1 shows consumption of purchased scrap and output of pig iron and steel ingots and castings from 1905 to 1938, inclusive.

Open-hearth steel furnaces use by far the largest quantities of ferrous scrap and pig iron. They consumed 68 percent of the total scrap in 1938 (69 percent in 1937), 70 percent of the home scrap (70 percent in 1937), 66 percent of the purchased scrap (69 percent in 1937), and 74 percent of the pig iron (74 percent in 1937).

Cupolas, the second largest consumers of scrap, took 24 percent of the purchased scrap in 1938 compared with 20 percent in 1937. They increased slightly their relative consumption of home scrap (15 percent) and pig iron (13 percent).

Open-hearth and cupola furnaces together consumed 85 percent of the home scrap, 90 percent of the purchased scrap, and 87 percent of the pig iron in 1938. Bessemer converters used 11 percent of the pig iron consumed in 1938 but only relatively small quantities of scrap (0.54 percent of the total). Although electric furnaces consumed only 4 percent of the scrap in 1938, 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, 1937–38, by type of furnace, in gross tons

Type of furnace or equipment	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
1937					
Open-hearth	142	13,957,619	12,456,418	26,414,037	25,118,216
Bessemer	[1] 30	221,460	9,043	230,503	3,688,335
Electric	[1] 268	[2] 827,057	[2] 898,765	[2] 1,725,822	[2] 44,715
Cupola	[1] 2,611	[3] 2,878,395	[3] 3,629,078	[3] 6,507,473	[3 4] 4,195,234
Air	[1] 121	[5] 513,075	[5] 231,221	[5] 744,296	[5] 444,988
Brackelsberg	2				
Crucible	13	815	551	1,366	43
Puddling	7	4,551	6,649	11,200	31,489
Blast	81	1,468,061	903,514	2,371,575	
Direct castings	13				[4] 533,507
	[1 6] 3,288	19,871,033	18,135,239	38,006,272	34,056,527
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	[4] 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				[4] 217,325
	[6] 3,266	11,321,341	10,023,593	21,344,934	18,504,349

[1] Revised figures.
[2] Revised to include 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron.
[3] Revised to include 12,814 tons of home scrap, 2,387 tons of purchased scrap, and 58,969 tons of pig iron; and to exclude 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron.
[4] Includes some pig iron used in making direct castings.
[5] Revised to exclude 12,814 tons of home scrap, 2,387 tons of purchased scrap, and 58,969 tons of pig iron.
[6] 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.

The percentage composition of charges to various types of furnaces, in terms of scrap and pig iron, are shown in the following table. The proportions of scrap and pig iron used in steel furnaces changed only slightly in 1938 compared with 1937. However, the proportion of total scrap used in iron furnaces (cupola and air) increased, whereas that of pig iron decreased.

Proportion of home and purchased scrap and pig iron used in furnace charges in the United States, 1937–38, in percent

Type of furnace	1937				1938			
	Scrap			Pig iron	Scrap			Pig iron
	Home	Purchased	Total		Home	Purchased	Total	
Open-hearth	27.1	24.2	51.3	48.7	28.1	23.4	51.5	48.5
Bessemer	5.7	.2	5.9	94.1	5.4	.2	5.6	94.4
Electric	46.7	50.8	97.5	2.5	47.6	50.7	98.3	1.7
Cupola	[1] 26.9	[1] 33.9	[1] 60.8	[1] 39.2	26.4	37.1	63.5	36.5
Air [2]	[1] 43.1	[1] 19.5	[1] 62.6	[1] 37.4	48.2	21.4	69.6	30.4
Crucible	57.8	39.1	96.9	3.1	41.4	43.4	84.8	15.2
Puddling	10.6	15.6	26.2	73.8	6.3	33.2	39.5	60.5
Blast	61.9	38.1	100.0	-------	71.8	28.2	100.0	-------

[1] Revised figures.
[2] Includes data for 2 Brackelsberg furnaces.

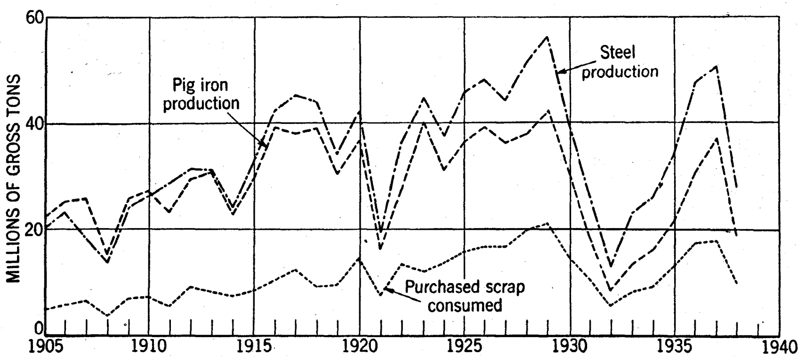

FIGURE 1.—Consumption of purchased scrap and output of pig iron and steel in the United States, 1905–38. Figures on consumption of purchased scrap for 1905–32 are from *State of Minnesota* vs. *Oliver Iron Mining Co. et al.*, Exhibits, vol. 5, 1935, p. 328; those for 1933–34 are estimates by author; and those for 1935–38 are based on Bureau of Mines reports. Figures on output of pig iron and steel are as given by the American Iron and Steel Institute.

PRICES [2]

Average prices of scrap iron and scrap steel in 1937 reached the highest levels since 1923 but had fallen off approximately 37 percent by the close of the year and fell still lower in 1938. The average price of No. 1 heavy-melting steel at Pittsburgh declined from $14.25 per gross ton at the beginning of 1938 to $11.30 the middle of June, then rose to $15.75 at the close of the year. No. 1 cast cupola scrap declined from an average of $16.25 at the beginning of 1938 to $13.45 in June, then rose to $15.50 by October where it remained to the end of the year. The price of basic pig iron, established at $23.50 per gross ton at Valley furnaces in April 1937, prevailed until late in June 1938, at which time it dropped to $19.50; in late September the price rose to $20.50 where it stood throughout the last quarter of the year.

[2] Price quotations from The Iron Age.

LEGISLATION

During the first half of 1938, when the trends of industrial activity and demand for scrap were downward, interest in scrap iron and scrap steel centered largely in the proposed embargo on exports. Senator Schwellenbach's bill (S. 2025, 75th Cong.) to restrict foreign shipments of ferrous scrap was patterned after the Faddis-Barbour bill (Public Law, 448, 74th Cong.), which prohibits exports of tin-plate scrap, waste-waste, strips, cobbles, etc., except under license issued by the President. Final hearings on S. 2025 were held in April 1938 before a subcommittee of the Committee on Military Affairs of the United States Senate. Extensive testimony was presented on both sides.[3] Pressure for the passage of the bill moderated after the slump in steel production and scrap prices which took place late in 1937 and early in 1938, and the bill died in committee. Further consideration of the proposal, however, is assured.

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 eight largest consuming States, which used 81 percent of the total scrap, 91 percent of the pig iron, and 85 percent of the total scrap and pig iron charged into furnaces in 1938. These States and the percentage of the total ferrous scrap and pig iron each consumed in 1938 were as follows: Pennsylvania 24, Ohio 21, Indiana 11, Illinois 8, Michigan, 6 Alabama 6, New York 5, and Maryland 4.

Total consumption of ferrous scrap and pig iron in the United States in 1938, 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	67	50,528	0.4	70,900	0.7	121,428	0.6	47,746	0.3
Maine	24	3,983	(1)	3,268	(1)	7,251	(1)	4,052	(1)
Massachusetts	119	57,265	.5	127,175	1.2	184,440	.8	59,774	.3
New Hampshire	17	1,667	(1)	1,647	(1)	3,314	(1)	1,248	(1)
Rhode Island	15	8,703	.1	17,446	.2	26,149	.1	14,362	.1
Vermont	15	3,161	(1)	3,520	(1)	6,681	(1)	3,019	(1)
Total New England	257	125,307	1.1	223,956	2.2	349,263	1.6	130,201	.7
Delaware	9	148,316	1.3	260,221	2.6	408,537	1.9	199,944	1.1
New Jersey	95								
New York	241	493,091	4.3	478,437	4.8	971,528	4.6	927,350	5.0
Pennsylvania	472	2,825,244	25.0	1,911,280	19.0	4,736,524	22.2	4,781,482	25.8
Total Middle Atlantic	817	3,466,651	30.6	2,649,938	26.4	6,116,589	28.7	5,908,776	31.9

[1] Less than 0.05 percent.

[3] Senate Hearings, Scrap Iron and Steel: 75th Cong., 1st Sess., S. 2025 and S. J. Res. 180, 63 pp.

Total consumption of ferrous scrap and pig iron in the United States in 1938, by States and districts—Continued

State and district	Active plants reporting	Scrap: Home, Gross tons	Scrap: Home, Percent of total	Scrap: Purchased, Gross tons	Scrap: Purchased, Percent of total	Scrap: Total, Gross tons	Scrap: Total, Percent of total	Pig iron: Gross tons	Pig iron: Percent of total
Alabama	88	512,911	4.5	374,811	3.8	887,722	4.2	1,395,369	7.5
District of Columbia	3								
Kentucky	26	733,041	6.5	313,458	3.1	1,046,499	4.9	1,353,414	7.3
Maryland	33								
Florida	17	23,278	.2	61,994	.6	85,272	.4	33,965	.2
Georgia	50								
Mississippi	10	421	(1)	990	(1)	1,411	(1)	327	(1)
North Carolina	45	10,200	.1	18,626	.2	28,826	.1	10,929	.1
South Carolina	18	1,620	(1)	2,515	(1)	4,135	(1)	1,533	(1)
Tennessee	59	81,748	.7	133,192	1.3	214,940	1.0	119,626	.7
Virginia	63								
West Virginia	33	213,405	1.9	339,022	3.4	552,427	2.6	501,920	2.7
Total Southeastern	445	1,576,624	13.9	1,244,608	12.4	2,821,232	13.2	3,417,083	18.5
Arkansas	17								
Louisiana	23	11,874	.1	45,168	.5	57,042	.3	1,797	(1)
Oklahoma	22								
Texas	52	23,284	.2	53,373	.5	76,657	.3	2,691	(1)
Total Southwestern	114	35,158	.3	98,541	1.0	133,699	.6	4,488	(1)
Illinois	230	877,793	7.8	1,001,411	10.0	1,879,204	8.8	1,468,762	8.0
Indiana	146	1,224,313	10.8	1,162,971	11.6	2,387,284	11.2	1,891,230	10.2
Iowa	62	54,391	.5	61,404	.6	115,795	.6	39,214	.2
Kansas	40	12,075	.1	37,736	.4	49,811	.2	2,529	(1)
Nebraska	16								
Michigan	201	1,002,802	8.9	860,952	8.6	1,863,754	8.7	980,742	5.3
Wisconsin	134								
Minnesota	69	77,946	.7	68,700	.7	146,646	.7	131,618	.7
Missouri	71	47,220	.4	316,449	3.1	363,669	1.7	25,319	.1
North Dakota	3	1,142	(1)	742	(1)	1,884	(1)	----------	------
South Dakota	2								
Ohio	359	2,529,499	22.3	1,631,818	16.3	4,161,317	19.5	4,274,412	23.1
Total North Central	1,333	5,827,181	51.5	5,142,183	51.3	10,969,364	51.4	8,813,826	47.6
Arizona	8								
Nevada	4	4,889	(1)	11,546	.1	16,435	.1	22	
New Mexico	1								
Colorado	26	83,353	.7	128,683	1.3	212,036	1.0	136,366	.7
Utah	15								
Idaho	4	123	(1)	1,611	(1)	1,734	(1)	2	
Wyoming	1								
Montana	7	2,665	(1)	2,802	(1)	5,467	(1)	194	
Total Rocky Mountain	66	91,030	.8	144,642	1.5	235,672	1.1	136,584	.7
Alaska	1								
Oregon	32	22,992	.2	80,014	.8	103,006	.5	4,927	(1)
Washington	63								
California	138	176,398	1.6	439,711	4.4	616,109	2.9	88,464	.5
Total Pacific Coast	234	199,390	1.8	519,725	5.2	719,115	3.4	93,391	.5
Total United States: 1938	[2] 3,266	11,321,341	100.0	10,023,593	100.0	21,344,934	100.0	18,504,349	100.0
1937	[2 3] 3,288	19,871,033	------	18,135,239	------	38,006,272	------	34,056,527	------

[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.
[3] Revised figures.

The following table shows the total consumption of ferrous scrap and pig iron by districts and the percentage change in the use of home scrap, purchased scrap, total scrap, and pig iron from 1935 to 1938.

Consumption of ferrous scrap and pig iron in the United States, 1935–38, 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	[2] 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
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	[2] 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
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	[2] 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
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	[2] 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
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	[2] 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
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
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
United States:									
1935	[3] 2,865	13,346,752	(1)	13,068,578	(1)	26,415,330	(1)	20,620,463	(1)
1936	[3] 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] 3,288	19,871,033	+5.1	18,135,239	+3.9	38,006,272	+4.5	34,056,527	+13.1
1938	[3] 3,266	11,321,341	−43.0	10,023,593	−44.7	21,344,934	−43.8	18,504,349	−45.7

[1] Canvass began in 1935.
[2] Revised figures.
[3] 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 was 28,337,001 gross tons in 1938, a decrease of 45 percent from 1937. Of the 1938 total, home scrap comprised 28 percent, purchased scrap 24 percent, and pig iron 48 percent; in 1937 the percentages were 27, 24, and 49, respectively. The use of home scrap decreased 43 percent, purchased scrap 47 percent, and pig iron 45 percent.

Charges to open-hearth furnaces consisted of 52 percent total scrap and 48 percent pig iron in 1938 compared with 51 and 49 percent, respectively, in 1937. Of the total scrap consumed in open hearths in 1938, 46 percent was purchased scrap compared with 47 percent in 1937 and 48 percent in 1936. Higher proportions of purchased scrap are used in areas remote from pig-iron producing centers. The practice of using scrap exclusively is relatively rare. In 1938 only 4 plants out of a total of 135 operated on a 100-percent-scrap basis; they consumed only 252,737 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 1938 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 1938, 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	1	28,633	120,324	148,957	28,198
Rhode Island	1				
Total: 1938	3	28,633	120,324	148,957	28,198
1937	4	50,822	206,422	257,244	46,771
Middle Atlantic:					
Delaware	1				
New Jersey	1	418,412	303,422	721,834	883,199
New York	7				
Pennsylvania	49	2,341,326	1,510,993	3,852,319	3,976,093
Total: 1938	58	2,759,738	1,814,415	4,574,153	4,859,292
1937	63	5,216,861	4,052,345	9,269,206	10,447,967
Southeastern and Southwestern:					
Alabama	3				
Georgia	1	277,456	293,844	571,300	1,051,938
Tennessee	1				
Oklahoma	1				
District of Columbia	1				
Kentucky	2	827,205	573,008	1,400,213	1,586,940
Maryland	1				
West Virginia	1				
Total: 1938	11	1,104,661	866,852	1,971,513	2,638,878
1937	12	1,495,324	1,483,300	2,978,624	3,376,208
North Central:					
Illinois	11	552,266	653,526	1,205,792	919,396
Indiana	7	1,048,557	1,008,554	2,057,111	1,681,107
Michigan	3	328,901	350,984	679,885	517,406
Iowa	1	10,446	206,699	217,145	4,755
Missouri	3				
Minnesota	1	64,476	22,658	87,134	120,222
Wisconsin	2				
Ohio	28	1,883,525	1,181,514	3,065,039	2,785,876
Total: 1938	56	3,888,171	3,423,935	7,312,106	6,028,762
1937	56	6,890,851	6,025,704	12,916,555	10,815,566
Rocky Mountain and Pacific Coast:					
Colorado	1				
California	5	174,948	425,953	600,901	174,241
Washington	1				
Total: 1938	7	174,948	425,953	600,901	174,241
1937	7	303,761	688,647	992,408	431,704
Total United States: 1938	135	7,956,151	6,651,479	14,607,630	13,729,371
1937	142	13,957,619	12,456,418	26,414,037	25,118,216

Bessemer converters.—The consumption of ferrous scrap and pig iron in bessemer converters totaled 2,061,494 gross tons in 1938, a decrease of 47 percent from 1937. The proportion of scrap consumed in converter practice is low, amounting to only 5.6 percent in 1938, and virtually the entire quantity was home or plant scrap. All 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 1938.

Consumption of ferrous scrap and pig iron in bessemer converters in the United States in 1938, 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				
Massachusetts	1				
New Jersey	1	717	538	1,255	604
New York	1				
Pennsylvania	7	25,242	767	26,009	365,811
Total: 1938	11	25,959	1,305	27,264	366,415
1937	12	46,787	3,506	50,293	881,614
Southeastern and Southwestern:					
Alabama	1				
Maryland	1				
West Virginia	1	16,371	766	17,137	129,728
Louisiana	1				
Total: 1938	4	16,371	766	17,137	129,728
1937	[1] 7	24,382	1,332	25,714	262,205
North Central:					
Illnois	3				
Indiana	1				
Michigan	1	8,197	1,622	9,819	295,965
Missouri	1				
Ohio	5	61,224	2	61,226	1,153,940
Total: 1938	11	69,421	1,624	71,045	1,449,905
1937	[1] 11	150,291	4,205	154,496	2,544,516
Total United States: 1938	26	111,751	3,695	115,446	1,946,048
1937	[1] 30	221,460	9,043	230,503	3,688,335

[1] Revised figures.

Electric steel furnaces.—Ferrous scrap and pig iron consumed in electric furnaces totaled 951,530 gross tons in 1938, a decrease of 46 percent from 1937. Pig iron comprised less than 2 percent of the total ferrous raw materials used in electric furnaces in 1938. Of the 257 active plants reporting in 1938, 96 operated exclusively on scrap and consumed 201,906 tons, or about 21 percent of the total scrap and pig iron used.

Ohio led all States in consumption of scrap in electric furnaces in 1938, followed by Pennsylvania, Illinois, Michigan, and California.

Consumption of ferrous scrap and pig iron in electric steel furnaces in the United States in 1938, by districts and States, in gross tons

District and State	Active plants reporting	Scrap: Home	Scrap: Purchased	Scrap: Total	Pig iron
New England:					
Connecticut	4	4,462	3,325	7,787	346
New Hampshire	1				
Rhode Island	1				
Massachusetts	7	2,831	4,708	7,539	32
Total: 1938	13	7,293	8,033	15,326	378
1937	13	15,579	12,727	28,306	2,336
Middle Atlantic:					
Delaware	1	9,827	17,981	27,808	248
New Jersey	4				
New York	19	18,292	22,059	40,351	1,162
Pennsylvania	49	97,811	91,532	189,343	2,874
Total: 1938	73	125,930	131,572	257,502	4,284
1937	[1] 75	204,396	228,676	433,072	10,791
Southeastern:					
District of Columbia	1	6,042	6,110	12,152	227
Maryland	2				
West Virginia	1				
Alabama	2	3,075	7,241	10,316	4
Florida	1				
Georgia	1				
Tennessee	1	5,245	2,612	7,857	111
Virginia	3				
Total: 1938	12	14,362	15,963	30,325	342
1937	[1] 11	14,690	25,240	39,930	251
Southwestern:					
Arkansas	1	3,456	5,036	8,492	144
Oklahoma	1				
Louisiana	3				
Texas	5	11,613	6,896	18,509	48
Total: 1938	10	15,069	11,932	27,001	192
1937 [2]	12	22,616	21,076	43,692	235
North Central:					
Illinois	18	40,485	74,472	114,957	1,461
Indiana	10	8,645	24,880	34,525	260
Iowa	1	2,179	3,669	5,848	47
Kansas	1				
Nebraska	1				
Michigan	21	58,300	40,540	98,840	5,717
Minnesota	3	2,005	908	2,913	49
Missouri	10	3,903	5,033	8,936	474
Ohio	25	121,103	95,146	216,249	1,193
Wisconsin	14	18,724	20,530	39,254	741
Total: 1938	104	256,344	265,178	521,522	9,942
1937	[1] 105	523,102	547,633	1,070,735	30,194
Rocky Mountain:					
Arizona	2	4,735	6,068	10,803	----------
Colorado	2				
Nevada	1				
Utah	1				
Total: 1938	6	4,735	6,068	10,803	----------
1937	7	7,827	7,333	15,160	----------
Pacific Coast:					
Alaska	1	2,624	4,554	7,178	10
Oregon	3				
California	22	22,484	21,592	44,076	713
Washington	13	4,515	17,389	21,904	32
Total: 1938	39	29,623	43,535	73,158	755
1937	[1] 45	38,847	56,080	94,927	908
Total United States: 1938	257	453,356	482,281	935,637	15,893
1937 [2]	[1] 268	827,057	898,765	1,725,822	44,715

[1] Revised figures.
[2] Revised to include 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron from Texas previously included under cupola furnaces.

Cupola furnaces.—Consumption of ferrous scrap and pig iron in cupola furnaces in 1938 totaled 6,596,539 gross tons, a decrease of 38 percent from 1937. Use of home scrap decreased 40 percent, purchased scrap 32 percent, total scrap 36 percent, and pig iron 43 percent. Thus the proportion of purchased scrap more than held its own; however, the relatively low price of scrap compared with pig iron was undoubtedly an important factor.

Charges to cupola furnaces in 1938 contained 26 percent home scrap, 37 percent purchased scrap, and 37 percent pig iron; in 1937 the percentages were 27, 34, and 39, respectively. Many cupola plants operate on 100-percent scrap charge, and 421 plants reported the consumption of 595,090 gross tons of ferrous scrap without the use of pig iron in 1938.

Michigan continued as the principal consumer of scrap in cupola furnaces in 1938, but the position of other States changed; Ohio, Pennsylvania, Illinois, and New York followed in decreasing order.

Consumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1938, by districts and States, in gross tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	53	32,828	23,021	55,849	32,566
Maine	23	3,906	3,268	7,174	4,052
Massachusetts	104	31,163	54,018	85,181	40,784
New Hampshire	15	868	1,647	2,515	998
Rhode Island	12	4,261	5,102	9,363	7,275
Vermont	15	3,161	3,520	6,681	3,019
Total: 1938	222	76,187	90,576	166,763	88,694
1937	[1] 223	132,962	159,608	292,570	165,608
Middle Atlantic:					
Delaware	5	803	1,398	2,201	983
New Jersey	83	51,709	179,172	230,881	116,058
New York	194	94,696	182,529	277,225	109,608
Pennsylvania	315	159,324	237,628	396,952	307,165
Total: 1938	597	306,532	600,727	907,259	533,814
1937	597	483,990	849,963	1,333,953	947,345
Southeastern:					
Alabama	75	97,349	108,845	206,194	360,322
District of Columbia	1	20,810	22,495	43,305	23,239
Maryland	27				
Florida	16	832	2,585	3,417	452
Georgia	48	10,571	15,196	25,767	16,838
Kentucky	22	15,441	13,016	28,457	34,304
Mississippi	10	421	990	1,411	327
North Carolina	45	10,200	18,626	28,826	10,929
South Carolina	18	1,620	2,515	4,135	1,533
Tennessee	56	57,296	65,610	122,906	83,689
Virginia	58	18,695	59,672	78,367	35,606
West Virginia	26	6,181	18,986	25,167	77,029
Total: 1938	402	239,416	328,536	567,952	644,268
1937	[1] 404	[2] 345,650	[2] 371,569	[2] 717,219	[2] 847,191
Southwestern:					
Arkansas	16	625	3,218	3,843	154
Louisiana	19	5,274	14,510	19,784	875
Oklahoma	20	1,981	4,989	6,970	414
Texas	47	11,671	46,477	58,148	2,643
Total: 1938	102	19,551	69,194	88,745	4,086
1937	96	[2] 28,169	[2] 100,527	[2] 128,696	[2] 23,243

See footnotes at end of table.

Comsumption of ferrous scrap and pig iron in cupola furnaces in the United States in 1938, by districts and States, in gross tons—Continued

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
North Central:					
Illinois	177	161,104	228,168	389,272	275,273
Indiana	112	78,501	109,248	187,749	75,029
Iowa	58	51,076	56,781	107,857	35,940
Kansas	38	8,928	29,578	38,506	1,599
Michigan	163	372,778	279,428	652,206	327,484
Minnesota	63	13,628	49,419	63,047	12,839
Missouri	56	30,536	105,976	136,512	18,815
Nebraska	15	1,810	5,951	7,761	922
North Dakota	3	1,142	742	1,884	
South Dakota	2				
Ohio	250	175,008	225,552	400,560	233,016
Wisconsin	108	133,126	82,712	215,838	98,634
Total: 1938	1,045	1,027,637	1,173,555	2,201,192	1,079,551
1937	[1] 1,057	1,798,030	1,936,927	3,734,957	2,115,595
Rocky Mountain:					
Arizona	6	2,299	8,719	11,018	
Colorado	21	7,205	18,379	25,584	7,948
Idaho	4	118	1,611	1,729	
Montana	7	2,665	2,802	5,467	194
Nevada	3	268	30	298	24
New Mexico	1				
Wyoming	1				
Utah	13	7,306	19,819	27,125	14,020
Total: 1938	56	19,861	51,360	71,221	22,186
1937	55	30,903	81,243	112,146	37,845
Pacific Coast:					
California	109	44,059	117,622	161,681	28,544
Oregon	29	2,389	6,217	8,606	1,920
Washington	49	5,056	13,427	18,483	1,574
Total: 1938	187	51,504	137,266	188,770	32,038
1937	[1] 179	58,691	129,241	187,932	58,407
Total United States: 1938	2,611	1,740,688	2,451,214	4,191,902	[3] 2,404,637
1937	[1] 2,611	[2] 2,878,395	[2] 3,629,078	[2] 6,507,473	[2,3] 4,195,234

[1] Revised figures.
[2] Revised to include 12,180 and 634 tons of home scrap, 1,930 and 457 tons of purchased scrap, and 58,497 and 472 tons of pig iron in West Virginia and Texas previously included under air furnaces and to exclude 925 tons of home scrap, 1,499 tons of purchased scrap, and 3 tons of pig iron from Texas now included under electric furnaces.
[3] Includes some pig iron used in making direct castings.

Air furnaces.—Ferrous scrap and pig iron consumed in air furnaces amounted to 610,726 gross tons in 1938, a decrease of 49 percent from 1937. The use of both home and purchased scrap decreased 43 percent and that of pig iron 58 percent. Thus, equipment of this type used relatively less pig iron than purchased scrap in 1938. Only six operators of air furnaces reported exclusive use of scrap in 1938, the quantity consumed amounting to 112,554 tons.

Ohio led in scrap consumption in air furnaces in 1938, followed by Indiana, Illinois, Wisconsin, and Pennsylvania.

Consumption of ferrous scrap and pig iron in air furnaces[1] *in the United States in 1938, by districts and States, in gross tons*

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	7	7,317	2,037	9,354	6,484
Massachusetts	3	5,359	2,344	7,703	6,070
New Hampshire	1				
Rhode Island	1				
Total: 1938	12	12,676	4,381	17,057	12,554
1937	[2] 11	28,829	10,068	38,897	24,681
Middle Atlantic:					
Delaware	1	4,534	1,329	5,863	4,119
New Jersey	3				
New York	11	13,951	6,004	19,955	10,586
Pennsylvania	21	23,554	14,465	38,019	27,403
Total: 1938	36	42,039	21,798	63,837	42,108
1937	36	108,778	47,238	156,016	103,518
Southeastern:					
Virginia	1	2,109	5,251	7,360	2,077
West Virginia	2				
Total: 1938	3	2,109	5,251	7,360	2,077
1937 [3]	3	3,211	4,167	7,378	5,068
North Central:					
Illinois	13	44,709	17,132	61,841	39,049
Indiana	11	59,589	13,514	73,103	19,924
Michigan	8	19,296	11,181	30,477	17,108
Iowa	1	4,854	2,059	6,913	5,965
Minnesota	1				
Missouri	1				
Ohio	23	83,503	33,456	116,959	35,279
Wisconsin	10	24,814	21,841	46,655	10,695
Total: 1938	68	236,765	99,183	335,948	128,020
1937	[2] 70	370,925	169,054	539,979	309,603
Rocky Mountain and Pacific Coast:					
Colorado	1	825	185	1,010	755
California	2				
Total: 1938	3	825	185	1,010	755
1937	3	1,332	694	2,026	2,118
Total United States: 1938 [1]	122	294,414	130,798	425,212	185,514
1937 [1] [3]	[2] 123	513,075	231,221	744,296	444,988

[1] Includes 2 Brackelsberg furnaces, 1 each in Indiana and Ohio in 1938, and 1 each in Michigan and Ohio in 1937.
[2] Revised figures.
[3] Revised to exclude 12,180 and 634 tons of home scrap, 1,930 and 457 tons of purchased scrap, and 58,497 and 472 tons of pig iron in West Virginia and Texas now included under cupola furnaces.

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, as the following table shows.

Consumption of ferrous scrap and pig iron in crucible and puddling furnaces in the United States in 1938, by districts and States, in gross tons

District and State	Active plants reporting	Scrap			Pig iron
		Home	Purchased	Total	
New England:					
Connecticut	2	219	416	635	142
Maine	1				
Massachusetts	3				
Total: 1938	6	219	416	635	142
1937	4	507	525	1,032	1
Middle Atlantic:					
New Jersey	3	259	295	554	513
New York	2				
Pennsylvania	8	524	1,827	2,351	2,856
Total: 1938	13	783	2,122	2,905	3,369
1937	9	3,311	3,865	7,176	27,494
Southeastern and North Central:					
Kentucky	1	106	1,003	1,109	2,003
Maryland	1				
Virginia	1				
Indiana	1				
Kansas	1				
Ohio	5	41	7	48	47
Total: 1938	10	147	1,010	1,157	2,050
1937	7	1,548	2,810	4,358	4,037
Total United States: 1938	29	1,149	3,548	4,697	5,561
1937	20	5,366	7,200	12,566	31,532

Blast furnaces.—Ferrous scrap constitutes only a small proportion of the metal-bearing materials consumed in blast furnaces. The other materials used in 1938 were 32,373,834 gross tons of iron and manganiferous iron ores, 2,271,055 tons of cinder and scale, and 951,000 tons of flue dust. Total consumption of scrap in 1938, as reported by 71 plants operating blast furnaces, was 1,064,410 tons, a decrease of 55 percent from 1937. Of the 1938 total, 72 percent was home scrap and 28 percent purchased scrap.

The proportion of scrap used in blast furnaces again declined in 1938, amounting to 5.7 percent of the pig iron produced in 1938 compared with 6.6 percent in 1937 and 6.9 percent in 1936. Purchased scrap was equivalent to 1.6 percent of the pig iron produced in 1938 compared with 2.5 percent in 1937 and 3.0 percent in 1936.

Blast furnaces in Ohio continued to consume more scrap in 1938 than those in any other State.

Consumption of ferrous scrap in blast furnaces in the United States in 1938, by districts and States, in gross tons

District and State	Active plants reporting	Scrap		
		Home	Purchased	Total
Middle Atlantic:				
New York	6	28,506	24,157	52,663
Pennsylvania	18	177,463	54,068	231,531
Total: 1938	24	205,969	78,225	284,194
1937	30	457,245	314,457	771,702
Southeastern:				
Alabama	7	147,513	26,867	174,380
Kentucky	1		8,112	8,112
Maryland	1	39,644	8,458	48,102
Tennessee	1		216	216
West Virginia	2	12,984		12,984
Total: 1938	12	200,141	43,653	243,794
1937	13	272,713	87,401	360,114
North Central:				
Illinois	5	78,426	27,341	105,767
Indiana	3	20,694	6,774	27,468
Iowa	1		700	700
Michigan	5	39,898	47,646	87,544
Minnesota	1	4,685	98	4,783
Ohio	18	205,095	96,141	301,236
Total: 1938	33	348,798	178,700	527,498
1937	36	729,139	500,786	1,229,925
Rocky Mountain:				
Colorado	1	8,924		8,924
Utah	1			
Total: 1938	2	8,924		8,924
1937	2	8,964	870	9,834
Total United States: 1938	71	763,832	300,578	1,064,410
1937	81	1,468,061	903,514	2,371,575

FOREIGN TRADE [4]

Imports.—Imports of iron and steel scrap into the United States, which are not of any great significance, amounted to 24,451 gross tons valued at $281,240 in 1938 compared with 81,640 tons valued at $1,153,206 in 1937. In addition, 10,444 tons of tin-plate scrap were imported in 1937, largely from Canada; 1938 receipts totaled 12,916 tons.

Exports.—Ferrous-scrap exports (all types) from the United States continued on a large scale in 1938. However, the tonnage and value decreased sharply from the record shipments of 1937. A total of 2,998,607 gross tons, valued at $45,833,916, was exported in 1938 compared with 4,101,549 tons, valued at $79,387,459, in 1937. The shipments included 24,216 tons of tin-plate scrap, waste-waste, strips, cobbles, etc., valued at $902,607 in 1938 compared with 53,447 tons, valued at $2,824,293, in 1937. The following table shows the principal countries to which shipments of scrap were consigned during the 5-year period, 1934–38.

[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.

Ferrous scrap exported from the United States, 1934–38, by countries, in gross tons

Country	1934	1935	1936	1937	1938
Canada	54,484	96,128	63,712	185,571	92,217
Germany	10,882	4,113	6,799	88,153	230,903
Italy	225,644	382,775	285,126	381,394	434,717
Japan	1,168,496	1,117,973	1,057,621	1,911,508	1,381,801
Netherlands	6,897	9,055	4,777	143,401	206,570
Poland	123,736	36,627	31,104	275,607	151,451
United Kingdom	134,434	277,366	364,874	847,177	387,347
Other countries	110,597	179,922	122,119	268,738	113,601
	1,835,170	2,103,959	1,936,132	4,101,549	2,998,607
Total value	$19,187,858	$22,949,070	$24,684,084	$79,387,459	$45,833,916

Of the total exports of ferrous scrap from the United States in 1938, 1,769,611 gross tons cleared through customs districts on the Atlantic coast (2,221,689 tons in 1937), 779,613 tons from districts bordering the Gulf of Mexico (1,389,828 tons in 1937), 368,842 tons from districts along the Pacific coast (342,707 tons in 1937), and 80,541 tons from other customs districts (147,325 tons in 1937).

Exports have been 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 great demand for scrap in steel-making in recent years has encouraged the intensive reclamation of scrap in all countries. In fact, several countries, including Germany, the United Kingdom, Japan, and Italy, have officially sanctioned campaigns to encourage the collection and utilization of scrap from all possible sources.

World requirements of scrap abated somewhat in 1938 because of a slowing down of steel production. According to Metal Statistics world production of steel ingots totaled 107,000,000 gross tons in 1938, a drop of 19 percent from the 132,500,000-ton record of 1937. The greater part of this decrease, however, occurred in the United States, and if this country is excluded world production fell only 4 percent from the 1937 levels.

In countries seeking self-sufficiency every effort is being made to increase the production of pig iron from domestic raw materials and thereby reduce the proportions of scrap used in steel-furnace charges. However, demand for steel has exceeded the growth of pig-iron production, with the result that scrap has been imported by these countries in ever-increasing quantities.

Cartel activities.—On March 11, 1937, producers of steel in 10 European countries organized a scrap-buying cartel for the purpose of purchasing and distributing scrap moving in international trade. Cartel members agree to buy all foreign scrap through the cartel's representative, the British Iron and Steel Federation in London. According to a report [5] the cartel bought 1,468,000 gross tons of scrap from the United States in 1938 and then divided the tonnage among its members. Italy, the leading European scrap importer, and the United Kingdom have taken much the largest part of the cartel's purchases.

[5] Daily Metal Reporter, vol. 39, No. 44, Mar. 8, 1939, pp. 1, 10.

Early in 1938 the Seiko Genryo Kowakai (Steel Materials Conference) decided upon a purchasing policy for the last half of 1938.[6] It was agreed that when steel makers who are not members of the conference desire to purchase scrap iron and scrap steel from the United States, specified as the major source of imports for Japan, such purchases should be entrusted to the conference which will make the purchase through its specified agent, Rokuyokai.

REVIEW BY COUNTRIES

Germany.—From 1930 to 1932, inclusive, Germany exported scrap iron and scrap steel but since then has imported it, taking larger quantities each year. Efforts have been made to conserve domestic scrap by increasing the amount of pig iron used in steel-making furnaces, and the drive for self-sufficiency has centered largely on the subsidized development of low-grade iron ores, inasmuch as Germany at present produces only about 50 percent of the ferrous raw materials, including scrap, required by its industry.[7] In 1938, partly owing to the acquisition of Austria and the Sudetenland from Czechoslovakia, Germany for the third successive year established a new record in steel production, by which that nation ranks second to the United States. However, the annexation of Austria and the Sudetenland has not enhanced Germany's position particularly, as the annual production of these territories is relatively small and in the past both have imported ferrous raw materials. Extensive propaganda to arouse the public to an understanding of the value of old materials has been decidedly successful. German municipalities having a population of more than 35,000 are obliged to sort and salvage old materials from refuse.

Italy.—In 1938 Italy regained its position among European nations as the largest importer of scrap iron and scrap steel from the United States, this country having supplied 66 percent of the total Italian imports in that year. Scrap is the principal ferrous raw material imported into Italy. Italian iron mines produce only about 35 percent of the requirements of the steel industry, and the rest is supplied largely by scrap imported from the United States and France and by domestic scrap. Application of sanctions against Italy in 1935 acted as an incentive toward greater self-sufficiency; and scrap imports, which exceeded 1 million tons in 1935, were reduced to less than one-half that figure by the end of 1938.[8]

Japan.—The production of steel ingots and castings in Japan has more than doubled since 1932, and the demand for ferrous raw materials has increased correspondingly. Pig-iron production has been expanded to meet part of the requirements; however, the proportions of scrap used in furnace charges also have increased, and imports of scrap iron and scrap steel are essential to the maintenance of the present steel-making rate. Early in 1938 the Japanese Department of Finance considered restricting imports of scrap and pig iron in order to balance the country's international account and tentatively set 1938 imports at one-half the 1937 total; thus the 1938 imports of scrap

[6] The Iron Age, vol. 141, No. 11, Mar. 17, 1938, p. 93–C.
[7] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 8, 9.
[8] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 11, 12.

would amount to about 1,500,000 metric tons.[9] Japanese military successes in China stabilized her credit in the fall of 1938. As a result, large orders for scrap iron and scrap steel were immediately placed with foreign suppliers. The United States is by far the leading source of imports of scrap into Japan. Heavy European demand and embargoes on exports of scrap in countries from which stocks might otherwise have been obtained have increased the share supplied by the United States. No other country has furnished Japan with as much as 10 percent of its total imports of scrap in recent years.

Poland.—In recent years the trend in Poland has been toward increasing the proportion of domestically produced pig iron used in steel making and thus minimizing the necessity of importing large tonnages of scrap iron and scrap steel. In 1938 imports of scrap dropped to approximately 390,000 gross tons, or 28 percent below the 1937 imports of 540,000 tons.[10] Expansion of blast-furnace capacity in Poland, as well as acquisition of the Trans-Olzan area from Czechoslovakia, is largely responsible for the reduction in Poland's imports of scrap. The addition of the Trans-Olzan area will increase Poland's annual pig-iron production by 500,000 tons or 55 percent and her steel output by 750,000 tons or 50 percent, thus satisfying Poland's most pressing need of steel for national defense.[11]

United Kingdom.—Abnormally large stocks of imported scrap iron and scrap steel on hand and on order in the United Kingdom in 1937, when demand for finished steel products suddenly disappeared, resulted in a sharp decrease of imports in 1938. The oversupplies, purchased largely in 1937, impeded the progress of domestic collectors of scrap in 1938 and brought severe censure of the British Iron and Steel Federation.[12] To meet the distress of the scrap merchants it was suggested that the British steel trade should stock all offered tonnages of home-collected scrap material to keep conditions fluid for the scrap industry.[13] Export restrictions, agreed upon by the scrap and steel industries in 1937, were removed, but the export prices placed much of the business out of reach of British merchants. However, special arrangements were made to sell surplus material to foreign buyers, and exports increased during the closing months of 1938.

[9] Daily Metal Reporter, vol. 38, No. 42, Mar. 2, 1938, p. 10.
[10] Waste Trade Journal, vol. 67, No. 1, Apr. 15, 1939, p. 15.
[11] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, pp. 12, 13.
[12] The Iron and Steel Trades in 1938: Wm. Jacks & Co., Special Review, London, p. 21.
[13] American Metal Market, vol. 45, No. 174, Sept. 8, 1938, p. 5.

IRON ORE, PIG IRON, FERRO-ALLOYS, AND STEEL

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

World production of iron and steel in 1938 receded from the record established in 1937 but was still at a high level. Although the total world figure shows the effects of this drop, the bulk of the decline took place in the United States. Foreign producers, stimulated by war conditions, heavy armament activities, and frantic attempts at national self-sufficiency, continued operations on a scale that was, in general, only slightly below the record levels of 1937; in fact, new production peaks were established in some countries, notably Germany, Italy, Japan, and the U. S. S. R. Some of the gain in Germany was due to territorial accession during 1938, but production in that country even as formerly constituted advanced. Output in Belgium, France, and Great Britain was off in 1938. World output of pig iron and steel each fell 20 percent in 1938 compared with 1937; American production dropped 48 and 44 percent, respectively, and the rest of the world only 4 and 5 percent. Of the total world putput of pig iron and steel in 1938 the United States furnished about 24 and 27 percent, respectively—the lowest proportionate share in more than half a century.

[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, 1937–38

	1937		1938	
	Gross tons	Value	Gross tons	Value
Iron ore:				
Production by—				
Districts:				
Lake Superior	[1] 61,657,635	(2)	21,308,410	(2)
Southeastern	6,351,053	(2)	4,325,729	(2)
Northeastern	3,145,177	(2)	2,306,910	(2)
Western	939,683	(2)	506,233	(2)
	72,093,548	(2)	28,447,282	(2)
Mining methods:				
Open pit	[3] 48,632,193	(2)	[3] 14,530,755	(2)
Underground	[3] 23,461,355	(2)	[3] 13,916,527	(2)
	72,093,548	(2)	28,447,282	(2)
Varieties:				
Hematite	[4] 68,072,781	(2)	[4 5] 25,607,467	(2)
Brown ore	[6] 666,374	(2)	363,146	(2)
Magnetite	[4 6] 3,353,861	(2)	[4 5] 2,476,221	(2)
Carbonate	532	(2)	448	(2)
	72,093,548	(2)	28,447,282	(2)
Shipments (exclusive of ore for paint)	72,347,785	$207,828,213	26,430,910	$74,322,405
Average value per ton at mine		2.87		2.81
Stocks at mines Dec. 31	5,526,564	(2)	7,611,048	(2)
Imports	2,442,069	5,841,637	2,122,455	5,288,195
Exports	1,264,102	4,039,248	591,524	1,954,287
Pig iron:				
Production	36,145,095	(2)	18,582,322	(2)
Shipments	35,224,347	731,139,435	18,202,354	356,875,369
Average value per ton at furnaces		20.76		19.61
Imports	111,697	1,701,304	30,400	598,461
Exports	782,436	19,403,285	432,851	7,135,129
Ferro-alloys:				
Production	1,008,170	(2)	584,724	(2)
Shipments:				
Ferromanganese	359,842	30,696,748	223,720	19,144,884
Spiegeleisen	134,983	3,969,822	24,939	80,830
Ferrosilicon	362,313	17,683,900	163,775	7,999,661
Other varieties	113,513	33,790,022	51,678	14,586,138
	970,651	86,140,492	464,112	41,811,513
Imports:				
Ferromanganese	29,558	2,163,616	26,258	1,770,948
Spiegeleisen	16,841	589,766	17,248	625,480
Ferrosilicon	12,930	349,207	5,325	134,067
Steel production:				
Open hearth:				
Basic	45,772,510	(2)	25,691,963	(2)
Acid	499,793	(2)	272,337	(2)
Bessemer	3,449,927	(2)	1,880,661	(2)
Crucible	934	(2)	6	(2)
Electric	845,537	(2)	505,024	(2)
	50,568,701	(2)	28,349,991	(2)

[1] Includes a small quantity of ore produced in southern Wisconsin.
[2] Figures not available.
[3] Some underground included with open pit.
[4] Small quantity of hematite included with magnetite.
[5] Small quantity of magnetite included with hematite.
[6] Small quantity of brown ore included with magnetite.

The domestic iron and steel industry in 1938 followed a pattern almost the reverse of that in 1937, and production was at a low level. As a result of sharply curtailed operations in the last quarter of 1937, the year opened with a low operating rate which persisted during the first 6 months. There was some improvement throughout the last half of the year, but the ground lost in 1937 was not regained. The peak production was attained in November, when 62 percent of the steel capacity was employed compared with 90 percent in April, the peak month of 1937. At the close of 1938 operations were definitely on a larger scale than during the opening months; the average rate of production in the last quarter was 56 percent compared with 32 percent in the first quarter. The average operating rate for 1938 was 40 percent of capacity compared with 72 percent in 1937. 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 lower demand in 1938. Domestic production of iron ore, the principal raw material, decreased 61 percent from 1937, was 56 percent below the 1925–29 average, and was the lowest since 1934. Figure 1 shows the trends in domestic production of iron ore, pig iron, and steel for more than half a century.

Although production of automobiles dropped 48 percent from 1937 to 2,489,635 units in 1938, the lowest since 1933, the automotive

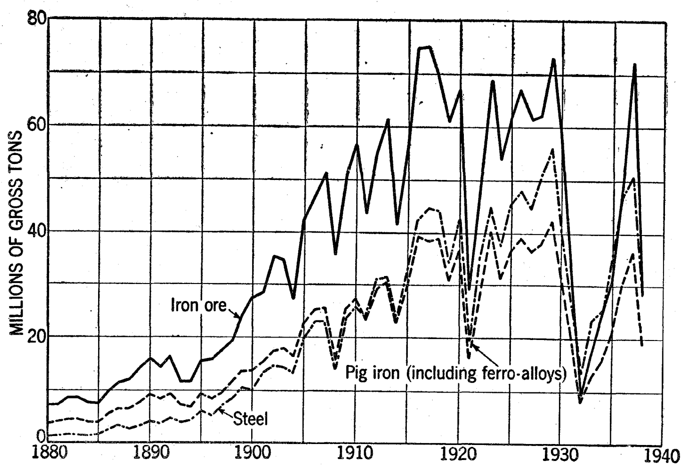

FIGURE 1.—Trends in production of iron ore, pig iron, and steel in the United States, 1880–1938.

industry remained the chief consuming outlet for steel, taking about one-sixth of the total. Agriculture had a good year, but prices of farm products were lower, resulting in an actual and relative decline in the quantity of steel moving into this outlet. Steel exported, though lower than in 1937, held up well and was more than double the quantity moving into agriculture. The relative quantities of steel used in containers were about the same in 1938 as in 1937.

The capital-goods industries continued the slump that began during the last quarter of 1937, less steel being demanded from this outlet. In periods of slack business activity, when large volumes of plant and equipment are idle, there is little incentive to expand existing facilities. Buying by the railroads was curtailed further by the drop in earnings during the year, particularly during the first two quarters, and purchases of all materials and equipment were more than 50 percent less than in 1937. New lightweight rolling stock designed for higher speeds has featured the railroad demand in recent years. Although this trend is more evident in the passenger branch, where high-speed,

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streamlined trains are being featured, it also applies to freight-moving equipment.

The construction industry experienced a better year in 1938 than in 1937, resulting in a larger consumption of steel. Public construction expenditures, which increased during the latter part of 1938, more than made up for the recession in private construction, reversing the condition in 1937. There was a decided slump in industrial building in 1938, and commercial building construction dropped about 6 percent. Despite the increase in 1938 the industry was far below predepression levels.

Reversing the trend of recent years, the price of steel was reduced materially in 1938 (see fig. 2); large inventories and low demand accounted for the decline. Price reductions during the year on nearly all steel products brought down the composite price of finished steel, as compiled by Iron Age, to 2.255 cents per pound in October from 2.512 cents at the beginning of the year; for November and December the figure was 2.286 cents. The average for the year was 2.394 cents, the highest in any year since 1924, except 1937. Changes in the basing point system in 1938, including abandonment of the Chicago and Birmingham differentials, also affected prices. The radical change in the method of pricing and selling steel, a system of some 15 years standing, was the most noteworthy feature of the industry in 1938. Pig-iron prices reflected the light demand, and while quotations held during the first 5 months of the year, prices were cut $4 a ton in the third quarter but advanced $1 a ton for fourth-quarter delivery. The Iron Age composite pig-iron price was $20.61 a ton at the end of the year compared with $23.25 at the beginning of the year. Spiegeleisen and ferromanganese prices also declined. The change in quotations came at midyear, when ferromanganese dropped $10 a ton to $92.50 at seaboard, duty paid, and spiegeleisen $5 a ton to $28. Prices of scrap fluctuated, but not as widely as in 1937. The downward trend was reversed at midyear, and by the end of the year prices were at a higher level than at the beginning. The quotation on Lake ores for the 1938 season maintained the increase established in 1937, the first since 1929.

Employee relationships, which have been receiving increased attention in recent years, were not as important a factor in 1938 as in 1937. Decline in employment in the iron and steel industries was marked, owing to the low rate of activity; nevertheless, wage rates were unchanged. 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 of adjustment of operations to varying economic conditions. There were no major strikes in the iron and steel industries in 1938, although the Bureau of Labor Statistics, United States Department of Labor, lists 85 strikes beginning in 1938 involving 29,372 workers and resulting in 397,022 man-days idle during the year. The wages-and-hours law, which provides a minimum of 25 cents per hour rate and a 44-hour week for the first year, became effective October 24, 1938, but the provisions of this act had little or no effect on the iron and steel industry.

Because steel making and finishing capacity is now physically able to take care of reasonable demands there was little addition to equipment in 1938. In many instances, the smaller returns from low operating rates necessitated lessened expenditure to conserve the cash position of the producer. However, some additional capacity was installed, resulting principally from the enlargement of present facilities, including a number of blast furnaces that were remodeled or relined. Two new blast furnaces, each of 1,000 tons daily capacity, were completed in 1938, one at Ecorse, Mich., and the other at Indiana Harbor, Ind. Eleven open-hearth furnaces (five at Indiana

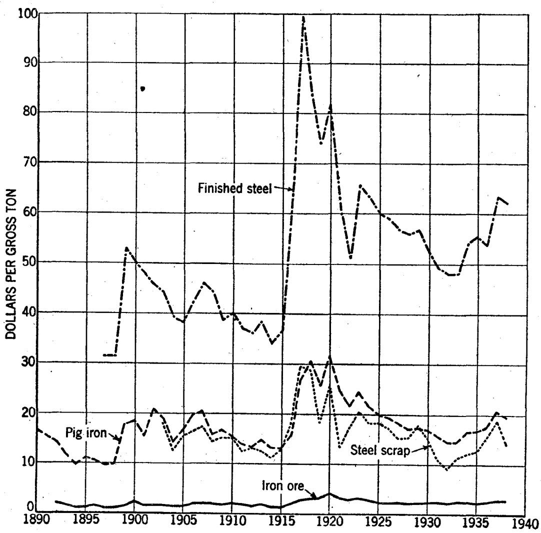

FIGURE 2.—Trends in prices of iron ore, pig iron, finished steel, and steel scrap, 1890–1938. The prices of iron ore and pig iron are the averages f. o. b. mines and furnaces, respectively, as reported to the Bureau of Mines; the price of finished steel is an average composite computed by American Metal Market; that of steel scrap is an average at Pittsburgh of No. 1 Heavy Melting, computed by Iron Age.

Harbor, Ind., four at Ecorse, Mich., and two at Gadsden, Ala.), with a total annual capacity of 931,300 tons, were completed in 1938. Capacity added to the finishing end of steel processes included completion of the Irvin works in the Pittsburgh district (Clairton) by the United States Steel Corporation.

Imports of iron ore into the United States decreased in 1938 from 1937 and comprised 7 percent of the domestic production, while imports of pig iron fell 73 percent and were only 0.2 percent of the domestic output. Imports of ferro-alloys also declined, but not so markedly, owing to the larger receipts of spiegeleisen and the comparatively smaller recession in ferromanganese. Imports of iron and steel manufactures, although relatively small, dropped abruptly in 1938 and were the lowest since 1921. Exports of iron and steel products were lower than in 1937 but still were at a good level; those of pig iron likewise dropped but maintained much of the large increase of 1937, while those for iron ore, largely to Canada, declined 53 percent. Ferro-alloy exports also were lower but do not represent much tonnage. Exports of scrap, which have attracted considerable attention in recent years, receded from the all-time peak established in 1937 but were still at a high level.

Import duties on a number of iron and steel products were lowered in 1938 under the Trade Agreements Act of June 12, 1934. These changes were provided for in the new trade agreement with Canada signed November 17, 1938, and effective January 1, 1939, which superseded the agreement signed November 15, 1935. There were also some changes, including a reduction in the duty on low-phosphorus (0.04 percent or under) pig iron from $1.125 to $0.75 per long ton, in the trade agreement with the United Kingdom, which likewise was signed on November 17, 1938, to become effective January 1, 1939.

CONSUMPTION OF FERROUS SCRAP AND PIG IRON

Data on the consumption of ferrous scrap, formerly included in this chapter, will be found elsewhere in this volume in the chapter on Scrap Iron and Steel. Data on consumption of pig iron will be found in the pig iron section of this report.

IRON ORE

Production and shipments.—Domestic output of iron ore in 1938 decreased 61 percent from 1937 and was the lowest since 1934. The 1938 tonnage was 56 percent below the 1925–29 average. Of the 172 mines (this figure does not include an undetermined number of very small open-pit operations) 4 produced more than a million tons each compared with 205 mines that included 12 in the million-ton class in 1937. Sixteen States were active producers in 1938 compared with 18 in 1937. Shipments of iron ore, which decreased 63 percent, were the lowest since 1934 and 60 percent below the 1925–29 average. The bulk of the iron ore mined in the United States is used in the manufacture of iron and steel; but 58,747 tons of the ore produced in 1938 were used for other purposes, including the manufacture of cement (46,830 tons), paint (9,694 tons), flux at nonferrous smelters (1,846 tons), and hydrogen gas (377 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 does not require treatment. Although included in the figures on production, the iron ore sold for the manufacture of paint—9,694 long tons in 1938 valued at $44,249 ($4.56 a ton) compared with 8,375 tons in 1937 valued at $48,005 ($5.73 a ton)—is not included in the shipments from mines. The output of manganiferous ore that contained 5 to 35 percent manganese also is not included; 308,860 tons valued at $858,356 were shipped in 1938 compared with 1,340,972 tons valued at $3,857,768 in 1937. In Arkansas, one producer shipped 2 tons of loadstone, which is not included in the iron ore statistics. 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 1938, 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	37	3,970,914	332,415			4,303,329
California	3	[1] 28,380		(1)		28,380
Georgia	4		9,221			9,221
Michigan	39	6,004,311				6,004,311
Minnesota	55	14,449,304				14,449,304
Missouri	[2] 13	20,213	8,331			28,544
New Jersey	3			185,639		185,639
New Mexico	1			1,826		1,826
New York	4	(3)		[3] 2,120,823	448	2,121,271
Pennsylvania	2					
Utah	2			167,933		167,933
Tennessee	2		13,179			13,179
Virginia	2					
Washington	2	3,555				3,555
Wisconsin	2	854,795				854,795
Wyoming	1	275,995				275,995
Total: 1938	[2] 172	[1][3] 25,607,467	363,146	[1][3] 2,476,221	448	28,447,282
1937	[2] 205	[3] 68,072,781	[4] 666,374	[3][4] 3,353,861	532	72,093,548

[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.
[4] Small quantity of brown ore included with magnetite.

Quantity and tenor of iron ore mined in the United States, 1937–38, by States and mining methods

State	1937				1938			
	Open pit (gross tons)	Underground (gross tons)	Total		Open pit (gross tons)	Underground (gross tons)	Total	
			Gross tons	Iron content (nat.), percent			Gross tons	Iron content (nat.), percent
Alabama	615,308	5,692,273	6,307,581	36.75	332,717	3,970,612	4,303,329	36.36
California	247		247	51.42	28,380		28,380	55.07
Georgia	14,498		14,498	38.05	8,944	277	9,221	39.33
Michigan	2,046,981	10,038,067	12,085,048	51.50	686,981	5,317,330	6,004,311	52.23
Minnesota	42,734,552	5,682,433	48,416,985	51.83	11,020,523	3,428,781	14,449,304	52.31
Mississippi	97		97	46.68				
Missouri	18,405	1,550	19,955	54.25	27,409	1,135	28,544	51.33
Nevada	196		196	65.00				
New Jersey		520,133	520,133	62.11		185,639	185,639	63.24
New Mexico	10,426		10,426	56.22	1,826		1,826	61.11
New York	[1] 2,625,044	(1)	2,625,044	67.20	[1] 2,121,271	(1)	2,121,271	67.10
Pennsylvania				40.79				42.76
Utah	190,908		190,908	54.50	167,933		167,933	54.11
Tennessee	28,359		28,359	43.38	13,179		13,179	47.15
Virginia	518		518	45.00				52.53
Washington	8,817	1,227	10,044	42.30	1,825	1,730	3,555	39.41
Wisconsin		1,155,602	1,155,602	53.47		854,795	854,795	53.26
Wyoming	337,837	370,070	707,907	52.80	119,767	156,228	275,995	52.80
	[1] 48,632,193	[1] 23,461,355	72,093,548	50.50	[1] 14,530,755	[1] 13,916,527	28,447,282	49.55

[1] Some underground included with open pit.

Iron ore mined in the United States, by mining districts and varieties in 1938, in gross tons

[Exclusive of ore containing 5 percent or more manganese]

District	Hematite	Brown ore	Magnetite	Carbonate	Total
Lake Superior	21,308,410				21,308,410
Birmingham	3,970,604	185,476			4,156,080
Chattanooga	310	52,861			53,171
Adirondack and Cornwall			[1] 2,120,823		[1] 2,120,823
Northern New Jersey			185,639		185,639
Other districts	[1 2] 328,143	124,809	[2] 169,759	448	[1] 623,159
	[1 2] 25,607,467	363,146	[1 2] 2,476,221	448	28,447,282

[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, 1937–38, by States

[Exclusive of ore containing 5 percent or more manganese and ore sold for paint]

State	1937		1938	
	Gross tons	Value	Gross tons	Value
Alabama	6,350,316	$10,747,967	4,281,332	$7,341,620
California	97	808	28,378	(1)
Georgia	14,593	19,130	9,221	11,375
Michigan	12,626,935	41,136,202	4,092,902	13,139,823
Minnesota	47,878,042	141,542,594	14,535,744	44,361,534
Mississippi	97	(1)		
Missouri	19,897	57,687	20,671	31,514
Nevada	196	(1)		
New Jersey	544,635	2,474,087	139,890	760,929
New Mexico	10,497	(1)	1,826	(1)
New York, Pennsylvania	2,547,082	5,823,286	2,232,837	5,867,320
Utah	188,794	(1)	169,947	(1)
Tennessee	28,359	89,761	13,456 (Tennessee and Virginia)	(1)
Virginia	518	(1)		
Washington	10,010	32,859	3,333	(1)
Wisconsin	1,419,810	4,473,942	625,378	1,886,477
Wyoming	707,907	(1)	275,995	(1)
Undistributed		[2] 1,429,890		[2] 921,813
	72,347,785	207,828,213	26,430,910	74,322,405

[1] Included under "Undistributed."
[2] This figure includes value for States entered as "(1)" above.

Principal mines.—The importance of large mining units in the iron-mining industry is shown by the fact that 13 mines, yielding more than 500,000 tons each, produced about half of the entire output in 1938. This situation, however, was not as pronounced in 1938 as in a year of heavy demand. In 1937, for example, a year of near-record output, 75 percent came from mines yielding 500,000 tons or more. In 1938, four operations—two in Minnesota, one in Alabama, and one in Pennsylvania—produced more than a million tons each compared with 12 in 1937. Of the 13 principal producing mines in 1938, 8 were open pits, 3 were operated by underground methods, and 2 were combination. Except for one mine that produced magnetite all other principal mines produced hematite.

Iron-ore mines of the United States that produced more than 500,000 gross tons each in 1938

Name of mine	State	Nearest town	District	Mining method	Gross tons
Red Mountain group	Alabama	Bessemer	Birmingham	Underground	2, 282, 382
Hull-Rust-Burt-Sellers group.	Minnesota	Hibbing	Mesabi	Open pit	2, 171, 810
Mahoning	do	do	do	do	1, 515, 572
Minnewas	do	Virginia	do	do	995, 590
Missabe Mountain	do	do	do	do	898, 118
Woodward No. 3	Alabama	Bessemer	Birmingham	Underground	869, 502
Adams-Spruce group	Minnesota	Eveleth	Mesabi	Combination	836, 480
Montreal	Wisconsin	Montreal	Gogebic	Underground	796, 780
Canisteo	Minnesota	Coleraine	Mesabi	Open pit	777, 881
Mesabi Chief	do	Nashwauk	do	do	597, 333
Hill Annex	do	Calumet	do	do	585, 783
Frazer	do	Chisholm	do	do	570, 951
Chateaugay [1]	New York	Lyon Mountain	Adirondack	Underground	[2] 2, 120, 823
Cornwall	Pennsylvania	Miners Village	Cornwall	Combination	
Witherbee Sherman group.[1]	New York	Mineville	Adirondack	Underground	
Total (15 mines)					[2] 15, 019, 005
Output of 5 mines producing between 400,000 and 500,000 tons each					2, 163, 962
Output of 6 mines producing between 300,000 and 400,000 tons each					2, 008, 435
Output of 14 mines producing between 200,000 and 300,000 tons each					3, 359, 184
Output of 22 mines producing between 100,000 and 200,000 tons each					3, 234, 601
Output of 26 mines producing between 50,000 and 100,000 tons each					1, 838, 952
Output of 84 [3] mines producing less than 50,000 tons each					[2] 823, 143
Grand total of United States (172 [3] mines)					28, 447, 282

[1] Produced less than 500,000 tons.
[2] Output of 2 mines producing less than 50,000 tons each included with output of mines producing more than 500,000 tons each.
[3] 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 43 mines in seven States in 1938 compared with 64 mines in six States in 1937. At many mines the ore is crushed and screened to improve its structure, but ore so improved is not included in the statistics of 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 1938 decreased 61 percent from 1937 and comprised 18 percent of the total shipments in 1938 compared with 17 percent in 1937.

Beneficiated iron ore shipped from mines in the United States, 1937–38

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Variety	1937		1938	
		Gross tons	Value	Gross tons	Value
Alabama	Brown ore	532, 570	$1, 297, 070	263, 766	$605, 226
Minnesota	Hematite and magnetite	9, 396, 874	26, 462, 257	2, 805, 996	8, 150, 937
New Jersey	Magnetite	542, 758	2, 472, 517	139, 890	760, 929
New York	do	1, 854, 249	5, 780, 303	1, 613, 602	4, 443, 421
Pennsylvania	do				
Tennessee	Brown ore	23, 685	78, 101	13, 181	34, 542
California	Magnetite				
		12, 350, 136	36, 090, 248	4, 836, 435	13, 995, 055

The quantity of crude ore beneficiated in the Lake Superior district (all in Minnesota) in 1938 totaled 5,112,485 gross tons and the beneficiated ore recovered 2,999,464 tons—a ratio of 1.704 to 1. In 1937 the crude ore treated totaled 15,746,547 tons and the beneficiated ore recovered therefrom 9,512,667 tons—a ratio of 1.655 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 Zapffe and Hunner.[2] Most of the concentrated ore shipped from Minnesota is obtained in the treatment of wash ores 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 and that a merchantable commodity can be produced.[3] The commercial possibilities have been discussed by Counselman.[4] In recent years there has been developed on the Mesabi range a process for roasting ore to the magnetic state and concentrating it on magnetic separators. The process, which is applicable to ores that cannot be concentrated either by washing or jigging, has been described by Davis.[5] A plant utilizing the process produced 6,361 tons of concentrates in 1938, which averaged (natural) 54.80 percent iron, 0.22 percent manganese, 0.046 percent phosphorus, 12.25 percent silica, and 10.04 percent moisture from 12,054 tons of jig tailings—a ratio of 1.895 to 1. The operation of the plant has been described by Craig.[6]

Beneficiated ore comprised a slightly larger part of the total shipments in 1938. Relieved of the pressure of production maintained in 1937, operators apparently did not find it necessary to supply a relatively larger proportion of the total from 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 1933, inclusive, are given in Minerals Yearbook, 1935.

Iron ore shipped from mines in the United States, 1925–29 (average) and 1934–38, 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 (aver.)	8,653,590	66,697,126	13.0	1936	9,658,699	51,465,648	18.8
1934	4,145,590	25,792,606	16.1	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

Average value.—The average value per gross ton of iron ore at the mines was $2.81 in 1938 compared with $2.87 in 1937.

The table that follows gives the average value at the mines of the different classes of iron ore in 1937–38 for each of the producing

[2] Zapffe, 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] Davis, E. W., First Magnetic Roasting Plant in the Lake Superior Region: Am. Inst. Min. and Met. Eng. Tech. Pub. 731, 1937, pp. 1–19.

[6] Craig, J. J., Magnetic Concentration on the Mesabi Makes Progress: Eng. and Min. Jour., vol. 139, No. 1, January 1938, pp. 48–52.

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 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, 1937–38

[Exclusive of ore containing 5 percent or more manganese and of ore sold for paint]

State	Hematite		Brown ore		Magnetite	
	1937	1938	1937	1938	1937	1938
Alabama	$1.62	$1.67	$2.39	$2.34		
Georgia			1.31	1.23		
Michigan	3.26	3.21				
Minnesota	2.96	3.05			(1)	
Missouri	5.91	1.51	(1)	(1)		
New Jersey			(1)		$4.56	$5.44
New York } Pennsylvania }					2.29	2.63
Tennessee			3.17	(1)		
Wisconsin	3.15	3.02				
Other States [2]	1.26	1.35	3.93	2.49	2.76	2.76
	2.89	2.82	2.40	2.31	2.69	2.79

[1] Less than 3 producers; permission to publish not given, therefore value may not be shown.
[2] 1937: California, Mississippi, Nevada, New Mexico, Utah, Virginia, Washington, and Wyoming; 1938: California, New Mexico, Tennessee, Utah, Virginia, Washington, and Wyoming.

Consumption.—The production of 18,582,322 gross tons of pig iron in 1938 required 32,373,834 tons of iron and manganiferous iron ores, 2,271,055 tons of mill cinder and roll scale, and 300,578 tons of purchased scrap, an average of 1.880 tons of metalliferous materials per ton of iron made.

The greater part of the iron ore used in Alabama furnaces in 1938 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 came chiefly from mines in 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 1938 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 1938 Alabama furnaces consumed an average of 2.460 tons of ore in making 1 ton of pig iron, the highest average for any State.

Maryland furnaces consumed considerable domestic ore in 1938 in addition to ores from Africa, Australia, Brazil, Chile, and Cuba. These furnaces used an average of 1.554 tons of ore per ton of pig iron; however, they used proportionately more cinder, scale, and scrap than furnaces in any other State.

Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, and West Virginia blast furnaces operated on 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, and the furnace at Standish handled magnetite from the Chateaugay mine at Lyon Mountain, N. Y. The furnace at Troy used chiefly magnetite from Mineville, N. Y., plus some manganese-bearing material from Canada in 1938.

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 Pennyslvania, New Jersey, and New York; and considerable ore from Australia, Chile, Cuba, India, Sweden, and the U. S. S. R.

The Pueblo (Colo.) blast furnaces employed hematite from the Sunrise mine in Wyoming, rhodochrosite from Butte, Mont., and manganese-bearing ores from Colorado and New Mexico.

The Provo (Utah) furnace consumed chiefly semialtered magnetite from the Iron Mountain mine near Cedar City, Utah, and manganese tailings from Philipsburg, Mont.

The Tennessee furnace used Tennessee brown ore and iron sinter.

Iron ore and other metallic materials consumed and pig iron produced in 1938, 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	4,957,932	19,298	63,465	5,040,695	2,023,269	2.460	0.031	2.491
Illinois	2,859,547		181,714	3,041,261	1,656,591	1.726	.110	1.836
Indiana	2,998,038		345,473	3,343,511	1,791,085	1.674	.193	1.867
Kentucky	190,178		20,552	210,730	126,102	1.508	.163	1.671
Maryland	457,672	1,409,541	245,338	2,112,551	1,201,374	1.554	.204	1.758
Michigan	900,970		92,329	993,299	556,230	1.620	.166	1.786
New York	2,328,868	6,005	53,428	2,388,301	1,338,907	1.744	.040	1.784
Ohio	6,890,525		582,007	7,472,532	4,210,514	1.637	.138	1.775
Pennsylvania	7,836,723	72,740	910,252	8,819,715	4,836,093	1.636	.188	1.824
West Virginia	799,006		38,537	837,543	472,738	1.690	.082	1.772
Undistributed [1]	646,791		38,538	685,329	369,419	1.751	.104	1.855
	30,866,250	1,507,584	2,571,633	34,945,467	18,582,322	1.742	.138	1.880

[1] Includes Colorado, Iowa, Minnesota, Tennessee, Utah, and Virginia.

Foreign iron and manganiferous iron ore consumed in the manufacture of pig iron in the United States, 1937–38, by sources of ore, in gross tons

Source of ore	1937	1938	Source of ore	1937	1938
Africa	4,184	8,711	Norway	3,983	
Asia	2,864	108	Spain	1,658	
Australia	140,372	61,473	Sweden	1,245	4,215
Brazil		9,597	U. S. S. R.	36,737	77
Chile	1,385,708	1,232,156	Undistributed	15,456	16,203
Cuba	452,553	175,044			
Newfoundland	32,045			2,076,805	1,507,584

Stocks at mines.—During 1938 stocks at the mines increased appreciably and at the end of the year were considerably above the low level of the two preceeding years. The increase during 1938 was 38 percent.

Stocks of iron ore at mines, Dec. 31, 1937–38, by States, in gross tons

State	1937	1938	State	1937	1938
Alabama	5,509	27,506	Pennsylvania	71,914	79,125
Michigan	3,371,190	5,299,847	Utah	2,014	----------
Minnesota	1,763,972	1,728,263	Virginia	3,363	3,086
Missouri	3,150	4,523	Washington	33	255
New Jersey	49,344	95,093	Wisconsin	126,064	356,579
New York	129,811	16,571			
North Carolina	200	200		5,526,564	7,611,048

Foreign trade.—Imports of iron ore in 1938 decreased 13 percent from 1937. Chile continued to be the chief source of imports into this country, furnishing 74 percent of the 1938 total, while Sweden supplied 10 percent and Cuba 7. In addition to the figures in the following table, 61 tons of dross or pyrites ash were imported from Canada.

Iron ore imported for consumption in the United States, 1936–38, by countries, in gross tons

Country	1936		1937		1938	
	Gross tons	Value	Gross tons	Value	Gross tons	Value
Algeria	12,293	$38,602	3,700	$17,424	7,480	$32,170
Australia	72,904	158,327	79,588	137,444	82,827	138,614
Brazil	6,102	22,209	11,000	26,620	9,650	44,170
Canada	83,911	407,230	5,046	44,156	875	26,441
Chile	1,264,130	2,291,010	1,438,886	2,608,696	1,577,750	2,853,060
Cuba	444,500	1,055,908	441,500	1,065,929	148,701	357,730
Germany	11	477	----------	----------	----------	----------
India, British	----------	----------	845	10,567	----------	----------
Iran (Persia)	2	84	3,385	55,713	5,648	90,969
Mexico	3,687	8,933	4,183	9,613	----------	----------
Newfoundland and Labrador	11,300	34,352	45,080	115,804	----------	----------
Norway	158,344	557,917	252,657	919,936	75,625	394,705
Philippine Islands	377	2,936	350	4,200	----------	----------
Spain	198	2,655	----------	----------	----------	----------
Sweden	166,150	678,451	150,233	796,953	213,616	1,339,393
U. S. S. R.	7,750	11,238	5,100	8,466	----------	----------
United Kingdom	570	9,868	516	20,116	228	10,131
Yugoslavia	----------	----------	----------	----------	55	812
	2,232,229	5,280,197	2,442,069	5,841,637	2,122,455	5,288,195

Exports of iron ore from the United States totaled 591,524 gross tons valued at $1,954,287 ($3.30 a ton) in 1938 compared with 1,264,102 tons valued at $4,039,248 ($3.20 a ton) in 1937. Of the 1938 total, 591,185 tons went to Canada.

Mining in Cuba.—Shipments of iron ore from Cuba to the United States decreased 69 percent in 1938 from 1937. The 1938 total of 152,099 gross tons included 95,721 tons of hematite carrying (dried) 54.86 percent iron and 45,491 tons of siliceous ore carrying (dried) 31.65 percent iron from the Daiquiri-Juragua mines on the southern coast and 10,887 tons of nodulized brown ore carrying (dried) 55.41 percent iron from the Mayari mines near the northern coast. The Mayari mine was idle during the last 9 months of the year.

The total stock of ore reported on hand was 170,044 gross tons at the end of the year compared with 86,787 at the end of 1937.

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, 1884–1938, 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
1884–1936	[1] 21,331,616	20,438	3,812,040	41,241	903,103	26,108,438
1937	452,882		35,537			488,419
1938	141,212		10,887			152,099
	21,925,710	20,438	3,858,464	41,241	903,103	26,748,956

[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.—Activities in the Lake Superior district (the principal producing district) were at a much lower rate in 1938. The abrupt decline in steel production during the last quarter of 1937, and the low operating rate that was maintained subsequently, reduced consumption; in consequence, abnormally high stocks accumulated at lower Lake ports and furnaces at the beginning of the 1938 shipping season. The larger stocks, together with the lower level of steel operations which continued throughout 1938, reduced the demand for Lake ores. Production decreased 65 percent and was the lowest since 1934. The district furnished 75 percent of the United States total in 1938 compared with 86 percent in 1937. The lower proportionate share is a result of higher rates of steel activity in districts depending on other ores, notably the Birmingham district.

Several ranges contribute to the district total. The Mesabi was the largest producer, contributing 62 percent of the district total and 47 percent of the United States total in 1938. 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, 1854–1938, by ranges, in gross tons

[Exclusive after 1905 of ore containing 5 percent or more manganese]

Year	Marquette	Menominee	Gogebic	Vermilion	Mesabi	Cuyuna	Total
1854–1936	189,309,480	179,272,258	201,274,214	63,288,269	984,192,997	24,538,932	1,641,876,150
1937	5,631,434	2,293,039	5,315,677	1,514,292	46,270,866	631,827	61,657,135
1938	2,686,713	1,283,563	2,888,830	932,505	13,256,605	260,194	21,308,410
	197,627,627	182,848,860	209,478,721	65,735,066	1,043,720,468	25,430,953	1,724,841,695

Much of the ore produced on the iron ranges of the Lake Superior district comes from open-pit mines. In 1938 this amounted to 55 percent. A large part of the open-pit production comes from operations on the Mesabi range, which in 1938 supplied 93 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. In the past the trend toward larger units, the replacement of steam by electric power on excavating shovels with caterpillar treads, and (to a more limited extent) the use of electric transportation equipment were the usual development. During the last few years, however, the increased use of trucks and the introduction of large belt conveyors to replace locomotive haulage out of pits are noteworthy. Small, standard-type dump trucks have been used in clean-up or scram operations within the pits, but during the 1936 season the first effort was made to use heavy truck haulage in transporting overburden and iron ore. The new units in use today range from 15 to 20 tons in capacity and are equipped with powerful gasoline or Diesel engines and supplemented by trailers or wagons on rubber or crawler treads.[7] Trucks handling 35 tons of ore have been tested at some properties. The moving of ore from pits, including the use of trucks and trailers, has been discussed by Moore,[8] while the application of trucks has been described by Whitney and Holt.[9] Conveyor belts originally were used in this district in concentrators and first applied to iron mining at the La Rue mine,[10] an underground operation. The use of tractors and wagons with caterpillar treads, and of conveyors for transporting ore from shovels to the surface is a feature of operations at the St. Paul pit near Keewatin. Crawling tractor trucks equipped with trailers are used to bring the ore to the conveyor-belt system, which is 900 feet long. Trucks and conveyor belts also are used at the Leetonia mine, whereas the Louise pit on the Cuyuna range uses Diesel-powered trucks only. In August 1937 a conveyor-belt system 4,481 feet long with a lift of 387 feet was put into operation at the Spruce open-pit mine, Eveleth, Minn., where the depth had reached the economical limit for steam-locomotive haulage. The Spruce open pit operated entirely under this new mining method throughout the 1938 shipping season. The new conveyor system, which will convey 750 tons per hour to a shipping pocket on the surface, extends under the ore body, and the ore is fed to the belt through raises equipped with jaw crushers and feeders. The ore is transported to the raises by tower excavators or by 20-ton trucks. The mining method has been described by Schwedes.[11] At the Judd pit on the western Mesabi range a truck-conveyor transport system with an 800-foot conveyor belt was erected in 1937. It

[7] Anderson, A. E., Riddell, J. M., and Holt, Grover, J., Recent Improvements in Mining Practice on the Mesabi Range: Am. Inst. Min. and Met. Eng. Tech. Pub. 968, November 1938, pp. 1–16.

[8] Moore, L. C., Open-Pit Transport on the Mesabi Range: Eng. and Min. Jour., vol. 139, Nos. 10, 11, 12, vol. 140, Nos. 1, 3, October, November, and December 1938; January, March 1939, pp. 44–47, 52–54, 50–52, 49–53, 46–48.

[9] Whitney, R. W., and Holt, G. J., Truck Haulage on the Mesabi and Cuyuna Ranges: Eng. and Min. Jour., vol. 140, No. 1, January 1939, pp. 29–33.

[10] Holt, G. J., Conveyor Transport in an Underground Mine on the Mesabi: Eng. and Min. Jour., vol. 139, No. 1, January 1938, pp. 29–31, 52.

[11] Schwedes, W. F., A New Method of Mining Mesabi Range Open Pit Iron Ore: Min. Cong. Jour., vol. 24, No. 12, December 1938, pp. 18–23.

is reported that similar operations are planned at other mines, as the combination of trucks, smaller shovels, and scrapers permits greater flexibility, and such equipment may be used alone as well as with the heavier railroad-type transportation equipment now predominating. Such operations permit removal of ore tied up in track benches and allow extraction closer to property lines. Smaller ore bodies and clean-up jobs around larger pits may also be handled. In addition, conveyor installations may be adapted to underground practice using top-slicing or sublevel-caving methods.

New methods in iron-mining technology are not confined to open-pit operations. A new circular ventilating shaft 5½ feet in diameter and 1,208 feet deep, using the shot-drill method developed at the Idaho-Maryland mine in California, was sunk during 1938 at the Zenith mine on the Vermilion range. This method of sinking mine openings is reported to be safer, cheaper, and faster than earlier methods.[12] The sublevel-caving method of mining used in the larger ore bodies at the Montreal mine in Wisconsin has been described by Bowen.[13]

A new handbook relating to the Lake Superior iron-mining industry has been published by the Lake Superior Iron Ore Association.[14] It contains chapters on history, geology, mineralogy, classification and sampling, grading, preparations for market requirements, shipment, and reduction; a directory of the mines; maps of all ranges; a flow map; and tables and charts showing shipments, distribution and consumption of ore, analyses, reserves, taxes, prices, and other pertinent information.

Shipments.—Interlake navigation in 1938 opened on April 13, but only 260,513 gross tons were shipped from Lake ports during the month compared with 3,770,555 tons in April 1937. The season's total was considerably below that in 1937 and with the exception of 1932 was the lowest since 1900. Shipments of ore from the Lake Superior district totaled 19,546,835 gross tons (19,254,171 tons of iron ore and 292,664 tons of manganese-bearing ores containing 5 percent or more manganese) in 1938 compared with 63,194,044 tons (61,926,405 tons of iron ore and 1,267,639 tons of manganese-bearing ores) in 1937. The iron ore statistics given above include 147 tons of paint ore in 1938 and 1,618 tons in 1937.

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,[15] and the method of classification and sampling has been described by Murray.[16]

[12] Newson, J. W., and Haselton, W. D., Borehole at the Zenith Mine, Ely, Minn.: Am. Inst. Min. and Met. Eng. Tech. Pub. 1068, February 1939, pp. 1–14.

[13] Bowen, R. A., Sublevel Caving, Large-Pillar Method, at the Montreal Mine: Am. Inst. Min. and Met. Eng. Tech. Pub. 886, February 1938, pp. 1–9.

[14] Lake Superior Iron Ore Association, Lake Superior Iron Ores: Cleveland, 1938, 412 pp.

[15] 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.

[16] Murray, C. B., Classification and Sampling: Lake Superior Iron Ores, Chap. 4, Lake Superior Iron Ore Association, Cleveland, 1938, pp. 69–72.

Average analyses of total tonnages of all grades of iron ore from all ranges of Lake Superior district, 1934–38

Year	Gross tons	Iron (natural)	Phosphorus	Silica	Manganese	Moisture
		Percent	*Percent*	*Percent*	*Percent*	*Percent*
1934	21,841,382	51.49	0.087	8.93	0.76	10.66
1935	28,214,056	51.44	.093	8.93	.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

Stocks at Lake Erie ports.—At the close of navigation in 1938, according to the Lake Superior Iron Ore Association, 5,290,294 gross tons were in stock at Lake Erie ports compared with 6,073,262 tons on the corresponding date in 1937. At the opening of navigation in May 1939, 4,484,967 tons were in stock at these ports, a decrease of 910,542 tons from the figure on May 1, 1938. Withdrawals from docks were therefore only 805,327 tons during the winter of 1938–39.

Prices of Lake Superior ore.—The prices established May 23, 1938, for the four standard grades of Lake Superior ore were the same as for 1937 but 45 cents per ton more than the price that had been maintained for 1929 to 1936. The unit prices for 1937 and 1938 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 per gross ton that correspond to these unit prices are, respectively, $5.25, $5.10, $5.10, and $4.95. The base of the four standard grades for 1925–38 is an iron content of 51.5 percent natural. For the bessemer grades the phosphorus content is 0.045 percent (dry), while for the nonbessemer grades the phosphorus content ranges from 0.045 to 0.18 percent. Ores containing over 0.18 percent phosphorus are classed as high-phosphorus ores, while 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, shown in the following tables cover developed and prospective ore in the ground and ore in stock piles. These estimates reveal a decrease from the previous year of 23,201,051 gross tons in Minnesota but an increase of 1,147,551 tons in Michigan. Reserves in Wisconsin have been estimated recently at 5,500,000 tons.

Iron-ore reserves in Minnesota, May 1, 1934–38, in gross tons

Range	1934	1935	1936	1937	1938
Mesabi	1,195,271,786	1,177,302,197	1,180,391,647	1,173,108,376	1,150,808,768
Vermilion	13,243,125	13,656,569	13,489,847	13,943,325	14,274,025
Cuyuna	47,553,536	46,874,462	63,226,789	61,922,739	60,690,596
	1,256,068,447	1,237,833,228	1,257,108,283	1,248,974,440	1,225,773,389

Iron-ore reserves in Michigan, Jan. 1, 1935–39, in gross tons

Range	1935	1936	1937	1938	1939
Gogebic	47,721,016	45,615,323	42,757,025	40,706,291	40,456,002
Marquette	53,513,561	52,461,173	51,339,347	49,869,363	52,130,385
Menominee	60,978,904	60,347,752	59,936,572	58,031,692	57,168,510
	162,213,481	158,424,248	154,032,944	148,607,346	149,754,897

MINING BY STATES

Alabama.—Although output of iron ore in Alabama was curtailed in 1938 the reduction was not as severe as in other large producing districts, and a number of mines that had been shut down resumed operations later in the year. Production in Alabama in 1938 decreased 32 percent from 1937. About 92 percent of the 1938 production came from underground mines and the remainder from open-cuts. Hematite represented 92 percent of the 1938 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 1938 Raimund Nos. 1 and 2, Red Mountain group (comprising the Muscoda, Wenonah, and Ishkooda groups), Sloss Nos. 1 and 2, Spaulding, and Woodward No. 3 mines contributed to production. The iron content of the hematite produced in 1938 averaged (natural) 35.49 percent, the manganese content 0.16 percent, the phosphorus content 0.31 percent, and the lime content 15.42 percent. The Red Mountain group with 2,282,382 tons was the largest producer in the United States in 1938.

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 1938 brown ore comprised 8 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 1938 averaged (natural) 47 percent iron and 0.72 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 1938 was small and came from three mines, one producing magnetite (in Santa Cruz County) and two producing hematite (one in San Bernardino County and one in Inyo County). The magnetite averaged 60 percent iron; the hematite, which averaged 55 percent iron, was absorbed chiefly by the cement industries.

Georgia.—Four mines in Bartow and Polk Counties furnished the output from Georgia in 1938. The Cartersville Barium Corporation in Bartow County was the largest producer. The entire output from Georgia was brown ore and contained (natural) 37 to 49 percent iron and 0.17 to 4 percent manganese.

Michigan.—Output from Michigan comes from three ranges—the Marquette, the Menominee, and the Gogebic. All ranges decreased their production in 1938, the Marquette showing the largest tonnage decline. Production in Michigan decreased 50 percent in 1938 from 1937 and totaled 6,004,311 gross tons. Eighty-nine percent of the 1938 total came from underground mines; the Maas mine, an underground producer on the Marquette range, was the largest producer. The iron content (natural) of the ore mined in 1938 averaged 52.23 percent compared with 51.50 percent in 1937.

Iron-ore reserves in Michigan at the end of 1938 totaled 149,754,897 gross tons, an increase of 1,147,551 tons during the year.

A report of the iron ore mines of Michigan for 1938, published by the Geological Survey Division of the Michigan Department of Conservation,[17] shows that the average number of men employed was 5,633 (6,230 in 1937), the average number of days worked 157 (238 in 1937), the average daily wage $7.59 ($7.05 in 1937), the average yearly earning $1,192.29 ($1,678.19 in 1937), and the average tons of ore mined per man per day 5.32 (7.12 in 1937).

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.

Average per-ton costs of mining iron ore at underground mines and at siliceous open pits in Michigan in 1938

Item	Underground				Siliceous open pits
	Gogebic	Marquette	Dickinson and Iron	Total	
Cost of mining	$2.0036	$2.0306	$1.9554	$2.0037	$0.6689
Deferred mining cost	.2622	.0732	.1275	.1480	.0596
Taxes	.4889	.4223	.2745	.4087	.0806
General overhead	.2670	.2606	.2409	.2580	.1305
Transportation	1.8194	1.5140	1.6326	1.6621	1.5176
Marketing	.0572	.1032	.0795	.0807	.0780
Royalty	.4163	.3138	.2767	.3390	.0879
Interest on borrowed money	.0009	.0054	.0014	.0079	.0001
Total ore cost	5.3155	4.7231	4.5885	4.9081	2.6232
Lake Erie value per ton	5.3916	5.2386	5.0166	5.2307	2.4412
Gross ore profit [1]	.0761	.5155	.4281	.3226	-.1820

[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 (1,134,886,487) of iron ore have been produced in Minnesota. In 1938 output decreased 70 percent from the record total in 1937. 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 1938 produced 13,256,605 tons. Output from open-pit mines in 1938 supplied 76 percent of the Minnesota total compared with 88 percent in 1937 and 86 percent in 1936. Of the four domestic mines producing more than 1 million tons each in 1938 two were in Minnesota, and both were open pits. Of the 55 mines in Minnesota active in 1938 (84 in 1937), 29 (51 in 1937) yielded more than

[17] 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, 1939.

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100,000 tons each. The iron content (natural) of the ore mined in 1938 averaged 52.31 percent compared with 51.83 percent in 1937.

According to the annual report of the mine inspector of St. Louis County, an average of 3,773 men was employed in iron mines in St. Louis County during 1938 (6,356 in 1937), and the average daily wage was $6.60 ($6.56 in 1937) for 8 hours. In 1938, 3,762,318 cubic yards of overburden were removed compared with 4,529,716 yards in 1937.

In Crow Wing County (Cuyuna range), 384 men were employed in 1938 compared with 894 men in 1937, according to the mine inspector's report. Two hundred and four thousand seven hundred and forty-two cubic yards of overburden were removed in 1938 compared with 1,670,862 yards in 1937.

According to the annual report of the mine inspector of Itasca County, an average of 2,132 men was employed in iron mines in 1938 (4,353 in 1937), and the average daily wage was $5.82 ($6.10 in 1937) for 8 hours. In 1938, 3,807,920 cubic yards of overburden were removed compared with 6,299,581 yards in 1937.

The data in the following table on costs of developing and mining iron ore have been abstracted from statistics published in greater detail by the Minnesota Tax Commission.

Average per-ton costs of developing and mining iron ore at open-pit and underground operations in Minnesota, 1933–37

Year	Developing	Mining			Royalty	Total
		Labor	Supplies	Other items		
Open-pit operations:						
1933	$0.259	$0.098	$0.116	$0.226	$0.419	$1.118
1934	.248	.135	.127	.205	.405	1.120
1935	.253	.137	.122	.172	.457	1.141
1936	.230	.149	.134	.197	.396	1.106
1937	.242	.169	.142	.151	.375	1.079
Underground or mixed operations:						
1933	.138	.700	.466	.352	.421	2.077
1934	.060	.809	.427	.303	.403	2.002
1935	.065	.764	.428	.249	.389	1.895
1936	.048	.774	.456	.275	.446	1.999
1937	.055	.973	.517	.283	.410	2.238

Iron ore reserves in Minnesota on May 1, 1938, totaled 1,225,773,389 gross tons, a decrease of 23,201,051 tons from the previous year.

Missouri.—An undetermined number of small operations in Butler, Carter, Crawford, Dent, Franklin, Howell, Oregon, Phelps, Pulaski, St. Francois, Shannon, and Wayne Counties supplied the iron ore output of Missouri in 1938. The ore, which averaged 51.33 percent iron, comprised both hematite and brown ore, was mined from open-pit and underground operations and was shipped to cement, paint, and steel plants.

New Jersey.—Output of iron ore in New Jersey decreased in 1938 from 1937 and totaled 185,639 tons. The ore, all magnetite and all produced from underground operations, came from three mines in Morris County in the northern part of the State. New Jersey ores are crushed and concentrated before shipment. The bulk 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 1938 averaged (natural) 63.24 percent iron. The largest output came from the Mt. Hope mine of the Warren Foundry & Pipe Corporation. The ore hoisted from this mine is hand-sorted and milled; the concentrates from the mill in 1938 averaged (natural) 63.16 percent iron. Other producers were the Scrub Oaks, which was idle most of the year, and Richard mines.

New Mexico.—One operation in New Mexico produced 1,826 gross tons of magnetite, carrying (natural) 61.11 percent iron in 1938. The ore was shipped to nonferrous smelters for fluxing purposes.

New York.—The production of iron ore in New York in 1938 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 1938 included sinter averaging 67 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.

The other large producer in New York (the Chateaugay Ore & Iron Co. at Lyon Mountain) produces both for its own consumption and for sale.

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 1938. A description of the operations at the Cornwall deposit has been given by Yaklish.[18]

Tennessee.—The output and shipments of iron ore in 1938 came from two mines (one in Hickman County and one in Lewis County), contained 47.15 percent iron, and were all brown ore.

In addition, considerable sintered pyrite ash was made at the plants of the Tennessee Copper Co. in Ducktown Basin. This sinter, which contained 66.6 percent iron and 0.005 percent phosphorus in 1938, 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. The situation regarding iron ores and the iron industries of the Tennessee Valley region has been outlined by Eckel.[19]

Texas.—There has been no commercial production of iron ore in Texas since 1921, but extensive deposits are known to exist. The following is a summary of a bulletin published by the Federal Geological Survey regarding deposits in eastern Texas.[20]

> The brown iron ore or limonite deposits described in this report occupy parts of the Coastal Plain province in eastern Texas. Ferruginous material is widely distributed, but the most promising deposits occupy small parts of Cass, Cherokee,

[18] Yaklish, J. P., The Iron Ore Deposit of Cornwall, Pa.: Explosives Eng., vol. 16, No. 11, November. 1938. pp. 327–333.
[19] Eckel, E. C., Iron Ores and Iron Industries of the Tennessee Valley Region: Tennessee Valley Authority Geologic Bull. 10, part 1, April 1938, pp. 1–17.
[20] Eckel, E. B., The Brown Iron Ores of Eastern Texas: Geol. Survey Bull. 902, 1938, pp. 1–157.

Marion, and Morris Counties. Since 1855 nearly 700,000 tons of ore has been produced. In the northern part of the field the ore occurs as nodules or thin lenses associated with more or less thoroughly weathered Weches greensand, of Eocene age. Farther south the ore forms one solid and nearly continuous bed at the top of the Weches. Chemical and other considerations indicate that the brown ore is derived from the greensand by weathering processes and that the two chief types of ore are due to differences in character of the parent greensand and to different ground-water conditions. Between 150,000,000 and 200,000,000 tons of comparatively high-grade ore is apparently available. These figures do not take into account an enormous tonnage of low-grade material that might possibly be used many years hence. The future of the district appears to depend largely on the solution of transportation problems. The report contains many analyses of the ores and detailed descriptions of all the important deposits. Geologic maps of parts of Cass, Marion, Morris, Cherokee, and Henderson Counties show the distribution and classification of the ores.

Utah.—Two operators in Iron County supplied the Utah total in 1938. 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) 54.11 percent iron and moved largely to the blast furnace at Provo, Utah, although small quantities went to steel plants and cement plants.

Virginia.—The output of iron ore in Virginia is small. All of the 1938 production was brown ore from Botetourt County and averaged (natural) about 53 percent iron. The ore was used chiefly in the manufacture of hydrogen gas.

Washington.—One open-pit and one underground mine produced the total output of Washington in 1938. The two mines—the Napoleon in Stevens County and the Keystone in Pend Oreille County—yielded hematite, averaging (natural) 39.41 percent iron, which was used for cement manufacture.

Wisconsin.—The Montreal mine, an underground operation in Iron County, was the larger producer of iron ore in Wisconsin, contributing 796,780 gross tons of the 854,795 produced in 1938. The ore—hematite—averaged (natural) 53.11 percent iron, 0.98 percent manganese, and 0.058 percent phosphorus. The Cary mine, also an underground operation in Iron County, was the other producer in 1938, furnishing 58,015 tons of hematite containing (natural) 55.39 percent iron, 0.39 percent manganese, and 0.043 percent phosphorus. Shipments from Wisconsin mines totaled 625,378 tons in 1938.

Wyoming.—The output of iron ore from Wyoming in 1938 came from the Sunrise mine and comprised 275,995 gross tons of hematite containing (natural) about 53 percent iron and 0.064 percent manganese. Much of the ore is a red, earthy hematite similar to Mesabi ore. Production came from open-pit and underground operations. Block-caving methods in use at this mine have been described by Rupp.[21]

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[21] Rupp, G. H., Block-caving at the Sunrise Iron Mine, Wyoming: Am. Inst. Min. and Met. Engr. Tech. Paper 1069, February 1939, pp. 1-16.

Iron ore mined in the United States, 1937–38, by States and counties

[Exclusive of ore containing 5 percent or more manganese]

State and county	1937 Active mines	1937 Gross tons	1938 Active mines	1938 Gross tons
Alabama:				
Bibb and Tuscaloosa	[1] 4	150,479	3	143,736
Blount	2	77,811	2	31,764
Butler, Conecuh, and Crenshaw	5	5,003	2	1,509
Calhoun	(2)	4,702	5	21,378
Cherokee	[1] 4	17,642	5	12,826
Chilton	[1] 2	24,499	2	5,559
Clay	2	435	-----	----------
Cleburne	1	1,240	2	2,138
Coosa	1	2,266	1	47
De Kalb	1	161	-----	----------
Etowah	2	3,740	1	77
Franklin	3	308,060	2	101,790
Jefferson	5	5,688,768	6	3,970,604
St. Clair	(2)	10,301	3	233
Shelby	2	11,377	2	4,417
Talladega	(2)	1,097	1	7,251
	[3] 34	6,307,581	37	4,303,329
California:				
Placer	1	247	-----	----------
San Bernardino	2		1	28,380
Inyo	-----	----------	1	
Santa Cruz	-----	----------	1	
	3	247	3	28,380
Georgia:				
Bartow	[1] 3	13,522	3	9,176
Polk	[1] 4	976	1	45
	[3] 7	14,498	4	9,221
Michigan:				
Dickinson	3	480,391	3	270,777
Gogebic	10	4,160,575	10	2,034,035
Iron	13	1,812,648	12	1,012,786
Marquette	15	5,631,434	14	2,686,713
	41	12,085,048	39	6,004,311
Minnesota:				
Crow Wing	7	631,827	4	260,194
Itasca	26	10,885,586	17	3,603,483
St. Louis	51	36,899,572	34	10,585,627
	84	48,416,985	55	14,449,304
Mississippi: Lafayette	1	97	-----	----------
Missouri:				
Butler, Carter, Crawford, Howell, Pulaski, Shannon, and Wayne	(4)	18,000	[5] 10	25,995
Phelps	1	114		
Dent	2	1,550	1	1,135
Franklin	-----	----------	1	1,200
Oregon	1	291	-----	----------
St. Francois	-----	----------	1	214
	[3] 4	19,955	[3] 13	28,544
Nevada: Lyon	1	196	-----	----------
New Jersey:				
Morris	3	520,133	3	185,639
Warren	2		-----	----------
	5	520,133	3	185,639
New Mexico: Grant	3	10,426	1	1,826
New York:				
Essex	1	2,624,512	1	2,120,823
Clinton	1		1	
Oneida	1		1	
Wayne	1		1	
	4		4	
Pennsylvania:				
Lebanon	1		1	
Carbon	1	532	1	448
	2	2,625,044	2	2,121,271
Utah: Iron	2	190,908	2	167,933
Tennessee:				
Dickson	1	28,359	-----	----------
Lawrence	1		-----	----------
Montgomery	1		-----	----------
Hickman	1		1	13,179
Lewis	1		1	
	5	28,359	2	
Virginia: Botetourt	1	518	2	
	1	518	2	13,179
Washington:				
Okanogan	1	983	-----	----------
Pend Oreille	1	1,227	1	1,730
Stevens	2	7,834	1	1,825
	4	10,044	2	3,555
Wisconsin:				
Dodge	1	500	-----	----------
Iron	2	1,155,102	2	854,795
	3	1,155,602	2	854,795
Wyoming: Platte	1	707,907	1	275,995
	[3] 205	72,093,548	[3] 172	28,447,282

[1] In addition, an undetermined number of small pits: Alabama—5 shippers in Bibb and Tuscaloosa Counties, 5 in Cherokee County, and 6 in Chilton County; Georgia—9 shippers in Bartow County and 5 in Polk County. The output from these pits is included in the tonnage given.

[2] Undetermined number of small pits: 17 shippers in Calhoun County, 5 in St. Clair County, and 6 in Talladega County.

[3] Excludes an undetermined number of small pits. The output of these pits is included in the tonnage given.

[4] Undetermined number of small pits operated by 1 producer.

[5] In addition, an 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 1938 is not yet available, nearly complete figures indicate that about 19,700 men working 30,388,000 man-hours were required to produce 28,447,282 tons of merchantable ore, an average of 0.936 ton per man-hour. Thus, the total man-hours worked in 1938 declined 41 percent from 1937, whereas the output of merchantable ore decreased 61 percent; in consequence, output per man-hour was 33 percent less. The decline in the output per man-hour in 1938 compared with 1937 was due mainly to a shift in the production of ore from open-pit to underground mines. Specifically, about half the output came from open-pit mines in 1938 compared with about two-thirds in 1937.

During 1937, the last year for which complete statistics are available, near-record output of iron ore resulted in an increase in labor at the

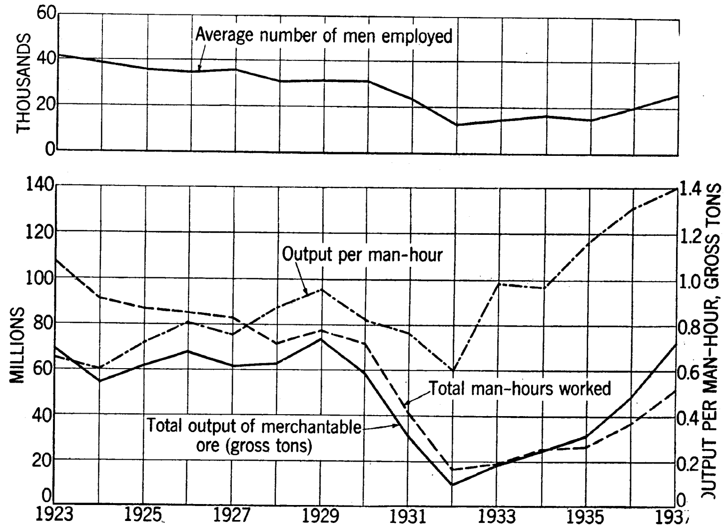

FIGURE 3.—Trends in number of men employed at iron ore mines, output of merchantable ore, man-hours worked, and output per man-hour in the United States, 1923–37.

mines. The average number of men increased, as did the average number of days worked, but the increase in man-hours did not parallel the increase in output, and as a result the output per man-hour again increased. In 1937, 25,945 men working 51,416,193 man-hours produced 72,093,548 tons of merchantable ore, an average output of 1.402 tons per man-hour, while in 1936, 20,306 men working 37,246,583 man-hours produced 48,788,745 tons of merchantable ore, or 1.310 tons per man-hour. Thus, while the average number of men employed increased 28 percent from 1936 to 1937 and the number of man-hours increased 38 percent, the output of merchantable ore increased 48 percent, resulting in an increase of 7 percent in the output per man-hour. 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 smaller labor requirements in 1937 than in 1936 resulted from several factors—proportionately larger outputs from open-pit mines and of direct shipping ore, nearer capacity production of operating units, and an increase in the number of days worked. Conversely, the stripping per ton of open-pit ore increased, but apparently this factor was overshadowed by the items listed above.

The number of man-hours of labor increased in all districts in 1937 over 1936, but the increase was relatively less in the Lake Superior district than in the other chief producing districts. In the Lake Superior district the output of merchantable ore per man-hour continued to increase, reaching 1.779 tons in 1937—11 percent more than in 1936. Despite the greater productivity, the large gain in output in 1937 over 1936—19,876,420 tons (48 percent)—required employment of only 26 percent more men; this, plus a small increase in the average number of days worked, caused a rise of 33 percent in the number of man-hours worked. Much of the Lake Superior output comes from Minnesota, where open pits furnished 88 percent of the ore in 1937. 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 1937 amounted to 2.479 tons, an increase of 11 percent over 1936. 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 5-year period 1933–37 compared with the 10-year period 1923–32 was due chiefly to the expansion of open-pit operations in Minnesota. For example, while about 75 percent of the merchantable ore produced in Minnesota from 1923 to 1932 came from open-pit mines, 86 percent was so produced in 1933–37. The significance of this shift can be appreciated when it is recalled that Minnesota contributed more than 61 percent of the total merchantable ore produced in 1923–37 and that during that period the output of men in open-pit operations averaged 2.029 tons per man-hour compared with only 0.696 ton per man-hour for workers at underground mines.

The greater output per man-hour in recent years also was due in part to the stripping of proportionately less overburden in Minnesota in 1933–37 in preparation for future mining than in 1923–32. In 1933–37 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 removed 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 lower man-hour cost of mining 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 during 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 beneficia-

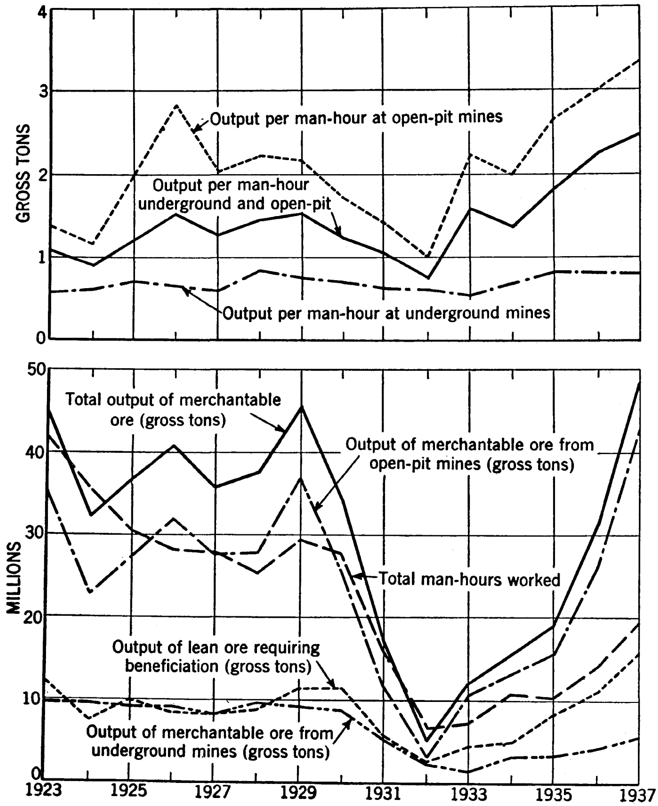

FIGURE 4.—Trends in output of merchantable iron ore per man-hour at open-pit mines in Minnesota compared with production of merchantable and lean ore and total man-hours worked, 1923–37.

tion has been mined in Minnesota in recent years than during the period 1923–32. In 1933–37, for instance, beneficiated ore represented 21 percent of the total merchantable ore compared with an average of only 16 percent in 1923–32.

The bulk of the ore 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 to 0.624 ton in 1937 from 0.582 ton in 1936. The largest and most consistent producing mines in the Southeastern district are in Jefferson County, Ala., where 4,030 men working 8,418,520 man-hours in 1937 produced 5,688,768 tons of merchantable ore, equivalent to an average output of 0.676 ton per man-hour. Virtually all ore produced in Jefferson County comes from underground operations. 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 or almost enough lime to make it self-fluxing. Thus, it should be recognized that the lower iron content is partly offset by the self-fluxing

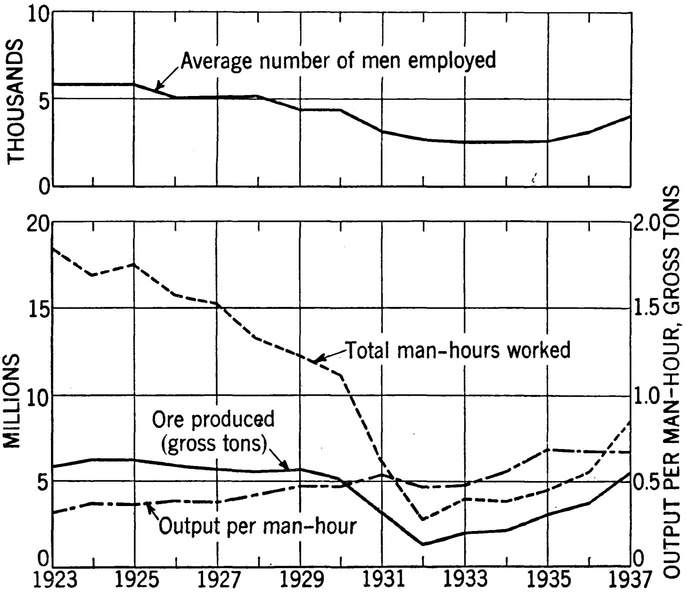

FIGURE 5.—Trends in production, man-hours worked, output per man-hour, and number of men employed at iron-ore mines in Jefferson County, Ala., 1923-37.

nature of the ore, although it is impossible to show this important characteristic in the productivity figures.

In the Northeastern district the average output of merchantable ore per man-hour decreased to 0.523 ton in 1937 from 0.603 ton in 1936. The drop in productivity was due in part to relatively larger increases in output from mines in New Jersey and New York, where virtually the entire output came from underground operations, resulting in a relatively higher expenditure of labor than in Pennsylvania, where output is predominantly from the open pit at Cornwall and productivity is high.

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 1937. Corresponding statistics and supplementary data are given in Minerals Yearbook, 1934 to 1938, inclusive.

Employment at iron-ore mines and beneficiating plants, quantity and tenor of ore produced, and average output per man in 1937, by districts and States

[Exclusive of ore containing 5 percent or more manganese]

District and State	Employment: Average number of men employed	Time employed: Average number of days	Time employed: Total man-shifts	Man-hours: Average per shift	Man-hours: Total	Production: Crude ore (partly estimated), gross tons	Merchantable ore: Gross tons	Merchantable ore: Iron contained: Gross tons	Merchantable ore: Iron contained: Percent natural	Average per man (gross tons): Crude ore (partly estimated): Per shift	Crude ore: Per hour	Merchantable ore: Per shift	Merchantable ore: Per hour	Merchantable ore: Iron contained: Per shift	Iron contained: Per hour
Lake Superior:															
Michigan	6,838	252	1,725,079	8.0	13,804,353	12,085,048	12,085,048	6,224,379	51.50	7.006	0.875	7.006	0.875	3.608	0.451
Minnesota	10,372	235	2,434,168	8.0	19,531,053	54,650,865	48,416,985	25,096,045	51.83	22.452	2.798	19.891	2.479	10.310	1.285
Wisconsin	626	262	164,203	8.0	1,313,634	1,155,602	1,155,602	617,846	53.47	7.038	.880	7.038	.880	3.763	.470
	17,836	242	4,323,450	8.0	34,649,040	67,891,515	61,657,635	31,938,270	51.80	15.703	1.959	14.261	1.779	7.387	.922
Southeastern:															
Alabama	4,906	253	1,242,651	8.1	10,024,673	7,600,938	6,307,581	2,317,993	36.75	6.117	.758	5.076	.629	1.865	.231
Georgia							14,498	5,517	38.05						
Mississippi	226	71	16,024	9.9	159,022	73,267	97	45	46.68	4.572	.461	2.713	.273	1.129	.114
Tennessee							28,359	12,301	43.38						
Virginia							518	233	45.00						
	5,132	245	1,258,675	8.1	10,183,695	7,674,205	6,351,053	2,336,089	36.78	6.097	.754	5.046	.624	1.856	.229
Northeastern:															
New Jersey	733	262	191,908	8.0	1,539,992	969,747	520,133	323,050	62.11	5.053	.630	2.710	.338	1.683	.210
New York	1,882	293	551,790	8.1	4,475,350	3,430,934	2,625,044	1,314,386	67.20	6.218	.767	4.757	.587	2.382	.294
Pennsylvania									40.79						
	2,615	284	743,698	8.1	6,015,342	4,400,681	3,145,177	1,637,436	52.06	5.917	.732	4.229	.523	2.202	.272
Western:															
California						247	247	127	51.42						
Missouri						19,955	19,955	10,825	54.25						
Nevada						196	196	127	65.00						
New Mexico	126	167	20,988	8.0	167,959	10,426	10,426	5,861	56.22	11.043	1.380	11.043	1.380	5.967	.746
Utah						190,908	190,908	104,051	54.50						
Washington						10,044	10,044	4,249	42.30						
Wyoming	236	212	50,020	8.0	400,157	707,907	707,907	373,776	52.80	14.152	1.769	14.152	1.769	7.473	.934
	362	196	71,008	8.0	568,116	939,683	939,683	499,016	53.10	13.233	1.654	13.233	1.654	7.028	.878
	25,945	247	6,396,831	8.0	51,416,193	80,906,084	72,093,548	36,410,811	50.50	12.648	1.574	11.270	1.402	5.692	.708

WORLD PRODUCTION

The following table shows the production of iron ore by countries from 1934 to 1938, insofar as statistics are available. Complete returns for 1938 are not yet available, but the data for 1937 are nearly complete. Output in 1937 was larger than in any other year, amounting to 213,700,000 metric tons, of which the United States supplied 34 percent. World production was lower in 1938, the curtailment amounting to about 25 percent.

Iron ore produced, 1934-38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
North America:					
Cuba (shipments)	181, 121	228, 408	456, 827	496, 258	154, 540
Guatemala				101	(2)
Mexico	105, 799	95, 590	123, 121	136, 018	118, 251
Newfoundland	514, 747	677, 137	907, 646	1, 635, 554	1, 707, 180
United States	24, 982, 047	31, 030, 423	49, 571, 804	73, 250, 649	28, 903, 861
South America:					
Brazil (exports)	7, 138	47, 184	110, 997	209, 715	359, 115
Chile [3]	969, 285	841, 300	1, 347, 831	1, 489, 637	1, 608, 399
Europe:					
Belgium	115, 890	164, 520	190, 660	265, 540	(2)
Bulgaria		2, 370	6, 498	11, 920	16, 771
Czechoslovakia	538, 742	731, 058	1, 089, 623	1, 836, 495	(2)
France	32, 015, 150	32, 045, 900	33, 301, 620	37, 839, 000	33, 137, 000
Germany [4]	4, 213, 869	5, 851, 634	7, 339, 836	9, 575, 234	10, 938, 650
Austria	466, 835	775, 421	1, 024, 288	1, 884, 694	2, 647, 000
Greece	147, 408	204, 146	280, 271	300, 498	(2)
Hungary	68, 870	192, 396	279, 673	289, 520	370, 000
Italy	484, 583	551, 454	838, 833	997, 805	(2)
Luxemburg	3, 833, 847	4, 133, 808	4, 895, 992	7, 766, 254	5, 048, 965
Norway	567, 414	765, 152	846, 809	1, 008, 225	1, 400, 000
Poland	247, 365	332, 536	466, 659	780, 152	872, 591
Portugal	2, 895	880	6, 539	7, 700	(2)
Rumania	83, 590	93, 813	108, 549	129, 005	(2)
Spain	2, 094, 001	2, 633, 165	(5)	990, 000	2, 513, 000
Sweden	5, 253, 058	7, 932, 854	11, 249, 605	14, 952, 549	(2)
Switzerland (exports)	18, 961	5, 894	31, 833	148, 578	133, 998
U. S. S. R. [6]	21, 508, 800	26, 845, 000	27, 918, 000	26, 000, 000	[7] 27, 000, 000
United Kingdom: Great Britain [8]	10, 756, 765	11, 070, 256	12, 905, 243	14, 443, 146	12, 049, 540
Yugoslavia	179, 841	234, 729	450, 859	629, 172	606, 884
Asia:					
Burma	24, 314	23, 456	26, 738	25, 834	(2)
China [9]	2, 544, 613	(5)	(5)	(5)	(2)
Chosen	176, 008	228, 220	234, 400	207, 500	(2)
India, British	1, 923, 370	2, 378, 788	2, 567, 488	2, 916, 909	2, 885, 357
Indochina	1, 500	635	10, 017	33, 285	(2)
Japan	431, 681	515, 529	754, 400	(5)	(2)
Malay States:					
Federated Malay States			457	1, 165	938
Unfederated Malay States	1, 153, 876	1, 434, 293	1, 681, 102	1, 686, 990	(2)
Philippine Islands (exports)	7, 239	283, 311	654, 458	601, 190	910, 952
U. S. S. R	(6)	(6)	(6)	(6)	(6)
Africa:					
Algeria	1, 326, 437	1, 674, 628	1, 884, 281	2, 427, 230	3, 105, 037
Egypt	203	15			(2)
Morocco:					
French				66, 864	266, 100
Spanish	824, 812	1, 167, 606	1, 052, 988	1, 420, 000	1, 341, 658
Northern Rhodesia			2	528	208
Sierra Leone	233, 148	440, 498	575, 689	644, 160	(2)
South-West Africa				14, 280	(2)
Tunisia	546, 500	503, 000	750, 000	943, 763	821, 630
Union of South Africa	233, 175	304, 048	364, 981	461, 796	505, 314
Oceania:					
Australia:					
New South Wales		7, 785			(2)
Queensland	3, 282	1, 137	2, 338	4, 551	5, 207
South Australia	1, 264, 205	1, 898, 712	1, 917, 589	1, 896, 370	2, 281, 404
Tasmania				62	(2)
New Zealand	2, 851	10, 817		580	1, 238
	120, 100, 000	140, 900, 000	173, 300, 000	213, 700, 000	(2)

[1] In addition to the countries listed Finland, Madagascar, and Turkey report production of iron ore, but complete data are not available. [2] Data not yet available. [3] Production of Tofo mines.
[4] Exclusive of manganiferous iron ore carrying 12 to 30 percent manganese. [5] Estimate included in total.
[6] Russia in Asia included with Russia in Europe. [7] Includes manganiferous iron ore.
[8] Exclusive of bog ore, which is used mainly for the purification of gas. [9] Including Manchuria.

PIG IRON

Production and shipments.—Domestic production of pig iron, exclusive of ferro-alloys, decreased 49 percent in 1938 from 1937 and was the lowest since 1934. The output in 1938 comprised 18,543,391 gross tons using coke and 38,931 tons using charcoal as fuel. Pennsylvania was the largest producer of pig iron in 1938, with 26 percent of the total; and Ohio ranked second, with 23 percent. Of the pig iron manufactured in 1938 it is calculated that 890,444 tons valued at $15,488,069 were made from 1,507,584 tons of foreign ores, including ore from Africa, Asia, Australia, Brazil, Chile, Cuba, Sweden, and the U. S. S. R., indicating an average yield of 59.06 percent from imported ore. Domestic ore (30,866,250 tons) and cinder, scale, and purchased scrap (2,571,633 tons) totaling 33,437,883 tons were reported used in the manufacture of 17,691,878 tons of pig iron, indicating an average pig-iron yield of 52.91 percent from domestic materials. In addition, 763,832 tons of home scrap and 951,000 tons of flue dust were consumed in making pig iron in 1938.

Shipments of pig iron, exclusive of ferro-alloys, in 1938, were 48 percent below 1937 and the lowest since 1934. The total value of shipments decreased 51 percent. 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 of pig iron published by trade journals.

Pig iron produced and shipped in the United States, 1937–38, by States

State	Produced		Shipped from furnaces			
	1937	1938	1937		1938	
	Gross tons	Gross tons	Gross tons	Value	Gross tons	Value
Alabama	2,580,674	2,023,269	2,528,785	$42,188,993	1,990,342	$29,190,091
Colorado	(1)	(1)	(1)	(1)	(1)	(1)
Illinois	3,426,480	1,656,591	3,357,959	70,893,278	1,519,572	30,899,012
Indiana	3,773,887	1,791,085	3,694,360	77,990,597	1,807,808	37,025,980
Iowa	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	243,010	126,102	243,010	(1)	126,102	(1)
Maryland	1,554,296	1,201,374	1,514,372	(1)	1,219,611	(1)
Massachusetts	(1)	----------	(1)	(1)	(1)	(1)
Michigan	948,429	556,230	886,602	15,064,083	558,782	9,806,994
Minnesota	253,942	(1)	248,363	(1)	135,931	(1)
New York	2,723,411	1,338,907	2,702,072	55,789,609	1,222,832	25,450,764
Ohio	7,917,215	4,210,514	7,724,882	167,076,855	4,186,217	85,186,824
Pennsylvania	11,371,238	4,836,093	11,036,467	239,838,942	4,684,017	101,266,844
Tennessee	(1)	(1)	(1)	(1)	(1)	(1)
Utah	(1)	(1)	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
West Virginia	722,531	472,738	685,086	(1)	496,905	(1)
Undistributed	[2] 629,982	[2] 369,419	[2] 602,389	[2] 62,297,078	[2] 254,235	[2] 38,048,860
	36,145,095	18,582,322	35,224,347	731,139,435	18,202,354	356,875,369

[1] Included under "Undistributed."
[2] Includes statistics for States entered as "(1)."

Pig iron shipped from blast furnaces in the United States, 1937–38, by grades

Grade	1937			1938		
	Gross tons	Value		Gross tons	Value	
		Total	Average		Total	Average
Charcoal	76, 790	$1, 879, 333	$24. 47	26, 558	$657, 885	$24. 77
Foundry	2, 811, 235	56, 679, 060	20. 16	1, 538, 349	28, 308, 696	18. 40
Basic	24, 676, 914	498, 478, 989	20. 20	13, 058, 455	250, 310. 020	19. 17
Bessemer	5, 328, 499	120, 288, 914	22. 57	2, 611, 015	56, 680, 050	21. 71
Low-phosphorus	244, 135	6, 348, 612	26. 00	120, 195	2, 830, 256	23. 55
Malleable	1, 994, 022	45, 123, 949	22. 63	765, 780	16, 489, 173	21. 53
Forge	23, 838	515, 730	21. 63	1, 347	27, 653	20. 53
All other (not ferro-alloys)	68, 914	1, 824, 848	26. 48	80, 655	1, 571, 636	19. 49
	35, 224, 347	731, 139, 435	20. 76	18, 202, 354	356, 875, 369	19. 61

The number of furnaces in blast on June 30 and December 31 and the total number of stacks recorded for 1937 and 1938, exclusive of electric reduction furnaces, were as follows:

Blast furnaces (including ferro-alloy blast furnaces) in the United States, 1937–38 [1]

State	In blast June 30, 1937	Dec. 31, 1937			In blast June 30, 1938	Dec. 31, 1938		
		In	Out	Total		In	Out	Total
Alabama	18	11	9	20	6	16	4	20
Colorado	3	1	2	3	2	1	2	3
Illinois	16	7	16	23	4	9	14	23
Indiana	14	7	11	18	5	8	11	19
Kentucky	2	1	1	2	1	1	1	2
Maryland	6	3	3	6	4	5	1	6
Massachusetts	1		1	1			1	1
Michigan	7	5	2	7	4	5	3	8
Minnesota	2	1	1	2	1	1	1	2
Missouri			1	1			1	1
New York	14	8	11	19	5	9	8	17
Ohio	36	20	28	48	17	29	19	48
Pennsylvania	62	28	53	81	20	29	49	78
Tennessee	1	1	4	5	1		3	3
Utah	1	1		1	1	1		1
Virginia	1		1	1	1	1		1
West Virginia	3	1	2	3	1	1	2	3
	187	95	146	241	73	116	120	236

[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 on 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 $19.61 a gross ton in 1938—$1.15 less than in 1937.

Average value per gross ton of pig iron at blast furnaces in the United States, 1934–38

State	1934	1935	1936	1937	1938
Alabama	$13. 81	$14. 67	$15. 01	$16. 68	$14. 67
Illinois	17. 72	17. 58	18. 24	21. 11	20. 33
Indiana	17. 60	17. 78	18. 14	21. 11	20. 48
Michigan	15. 49	15. 64	15. 56	16. 99	17. 55
New York	15. 20	15. 95	15. 87	20. 65	20. 81
Ohio	16. 45	16. 70	17. 02	21. 63	20. 35
Pennsylvania	18. 06	18. 38	18. 82	21. 73	21. 62
Other States [1]	15. 75	14. 46	17. 50	18. 92	17. 04
Average for United States	16. 73	16. 91	17. 59	20. 76	19. 61

[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, 1937–38 [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	
	1937	1938	1937	1938	1937	1938	1937	1938
January	$21.00	$24.00	$17.38	$20.38	$21.50	$24.50	$20.50	$23.50
February	21.13	24.00	17.41	20.38	21.63	24.50	20.63	23.50
March	23.72	24.00	19.92	20.38	24.22	24.50	23.22	23.50
April	24.00	24.00	20.38	20.38	24.50	24.50	23.50	23.50
May	24.00	24.00	20.38	20.38	24.50	24.50	23.50	23.50
June	24.00	23.35	20.38	19.61	24.50	23.85	23.50	22.85
July	24.00	20.00	20.38	16.38	24.50	20.50	23.50	19.50
August	24.00	20.00	20.38	16.38	24.50	20.50	23.50	19.50
September	24.00	20.16	20.38	16.54	24.50	20.66	23.50	19.66
October	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
November	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
December	24.00	21.00	20.38	17.38	24.50	21.50	23.50	20.50
Average	23.49	22.21	19.84	18.58	23.99	22.71	22.99	21.71

[1] Metal Statistics, 1939.

Foreign trade.—Imports of pig iron for consumption in 1938 declined 73 percent from 1937 owing to lower receipts from European nations and British India. The Netherlands supplied 47 percent of the 1938 total.

Pig iron imported for consumption in the United States, 1934–38, by countries, in gross tons

Country	1934	1935	1936	1937	1938
North America: Canada	8,984	13,771	11,603	6,638	2,656
South America: Chile	89				
Europe:					
Belgium	100	100	973		
Czechoslovakia			37		
France		50			
Germany	100	4,877	4,749	510	
Netherlands	65,439	48,122	60,363	28,772	14,236
Norway	1,203	2,420	2,649	875	850
Sweden	991	907	689	600	205
U. S. S. R.		9,124	24,556	4,581	
United Kingdom	600	14,500	4,354	100	42
Asia:					
Hong Kong			200		
India, British	36,013	37,016	55,426	69,621	12,411
Japan		50			
Kwantung	969		209		
	114,488	130,937	165,808	111,697	30,400
Value	$1,465,475	$1,979,324	$2,336,236	$1,701,304	$598,461

Exports of pig iron from the United States in 1938 decreased to 432,851 gross tons from 782,436 in 1937 but were still much higher than normal. Japan (73 percent) and the United Kingdom (9 percent) together took 82 percent of the total.

Pig iron exported from the United States, 1937–38, by countries, in gross tons

Country	1937	1938
North America:		
Canada	5,159	4,759
Other North America	1,722	506
South America:		
Chile	2,644	1,426
Other South America	1,216	524
Europe:		
Belgium	10,703	3,349
Czechoslovakia	6,255	60
France	14,229	12,241
Germany	20,992	10,075
Hungary		13,825
Italy	10,003	6,672
Netherlands	2,910	610
Poland and Danzig	2,448	200
Spain	10,492	350
Sweden	24,148	3,603
United Kingdom	233,218	40,615
Other Europe	861	121
Asia:		
China	16,635	6,553
Hong Kong	1,611	1,970
Japan	409,241	316,280
Kwantung	2,000	
Philippine Islands	1,099	734
Other Asia	1,125	665
Africa:		
Algeria		6,236
Egypt	500	
Union of South Africa	3,225	1,462
Oceania: New Zealand		15
	782,436	432,851
Value	$10,403,285	$7,135,129

Consumption.—The consumption of pig iron dropped 46 percent in 1938 from 1937. Pig iron, a product of the blast furnace, is a semiraw material and, except for the small quantity used in direct castings (about 1 percent of the total consumption), moves to other type furnaces for further refining or mixing 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 1938, as in recent years, about 85 percent of the pig iron was consumed in steel making. The open hearths, however, are taking a proportionately larger share, increasing progressively from 70.7 percent of the total in 1935 to 74.2 percent in 1938, while the bessemer furnaces dropped from 14.1 to 10.5 percent. With direct castings taking about 1 percent of the total, the remaining 14 percent is 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 the years 1935 to 1938, inclusive, the period for which data are available, 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 proportions of scrap to pig iron used in steel furnaces changed only slightly in 1938 compared with 1937, while the proportion of pig iron in cupola furnaces decreased.

Consumption of pig iron in the United States, 1935–38, by type of furnace

Type of furnace or equipment	1935		1936		1937		1938	
	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total	Gross tons	Percent of total
Open hearth	14,575,239	70.7	21,960,842	73.0	25,118,216	73.8	13,729,371	74.2
Bessemer	2,911,719	14.1	3,635,562	12.1	3,688,335	10.8	1,946,048	10.5
Electric	33,186	.2	22,866	.1	44,715	.1	15,893	.1
Cupola [1]	2,675,827	13.0	3,633,720	12.1	4,195,234	12.3	2,404,637	13.0
Air	295,008	1.4	407,038	1.3	} 444,988	1.3	185,514	1.0
Brackelsberg								
Crucible	566	(2)	34	(2)	43	(2)	218	(2)
Puddling	13,492	.1	30,498	.1	31,489	.1	5,343	(2)
Direct castings [1]	115,426	.5	408,074	1.3	533,507	1.6	217,325	1.2
	20,620,463	100.0	30,098,634	100.0	34,056,527	100.0	18,504,349	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, in the District of Columbia, and Alaska. As expected from the nature of its use the great concentration of consumption is in the iron and steel-making centers of the North Central, Middle Atlantic, and Southeastern States. These areas in 1938 used 98 percent of the pig iron, Pennsylvania (the leading consumer) taking nearly 26 percent of the total and Ohio (a close second) 23 percent. Of the consuming areas in 1938 the Southeastern district, including the Birmingham district of Alabama, recorded the smallest decline from 1937—24 percent compared with 53 percent in the Middle Atlantic district and 45 percent in the North Central. In Alabama consumption dropped 23 percent. The following table shows the distribution of pig iron consumption by States from 1935 to 1938, inclusive.

Consumption of pig iron in the United States, 1935–38, by States and districts

State and district	1935		1936		1937		1938	
	Consumers	Gross tons	Consumers	Gross tons	Consumers	Gross tons	Consumers	Gross tons
Connecticut	50	60,884	53	79,208	58	87,912	57	47,746
Maine	14	6,185	16	9,257	16	8,824	16	4,052
New Hampshire	13		13		13	2,180	14	1,248
Massachusetts	84	75,991	87	75,389	103	98,407	98	59,774
Rhode Island	14		13	25,983	14	35,140	13	14,362
Vermont	13	3,596	14	3,866	14	7,086	13	3,019
Total New England	188	146,656	196	193,703	218	239,549	211	130,201
Delaware	3	144,114	6	215,460	7	309,065	7	199,944
New Jersey	73		79		81		80	
New York	173	848,061	191	1,371,661	192	1,793,421	194	927,350
Pennsylvania	325	5,452,948	341	9,074,405	348	10,578,554	345	4,781,482
Total Middle Atlantic	574	6,445,123	617	10,661,526	628	12,681,040	626	5,908,776
Alabama	47	912,763	50	1,453,524	59	1,802,027	59	1,395,369
District of Columbia	2	2,441	1	501	1	444	1	1,353,414
Kentucky	17	307,037	18	1,489,375	22	1,724,693	21	
Maryland	20	1,497,930	24		25		26	
West Virginia	17		21	648,882	22	746,015	22	501,920
Florida	8	32,905	9	41,051	11	64,357	10	33,965
Georgia	31		34		40		40	
Mississippi	6	200	7	351	7	301	6	327
North Carolina	24	7,951	26	11,064	27	11,033	30	10,929
South Carolina	9	1,472	14	1,912	12	2,086	13	1,533
Tennessee	42	102,665	46	142,994	53	143,542	53	119,626
Virginia	41		44		45		44	
Total Southeastern	264	2,865,364	294	3,789,654	324	4,494,498	325	3,417,083
Arkansas	1	987	3	2,273	6	4,732	5	1,797
Oklahoma	7		8		9		7	
Louisiana	7	366	8		8		8	
Texas	22	3,657	20	4,699	22	19,171	23	2,691
Total Southwestern	37	5,010	39	6,972	45	23,903	43	4,488
Illinois	165	1,778,833	176	2,770,746	193	3,077,837	182	1,468,762
Indiana	97	2,408,095	109	3,473,415	116	3,661,133	120	1,891,230
Iowa	43	100,894	41	62,576	51	80,893	51	39,214
Minnesota	48		48	46,024	49	206,903	52	131,618
Missouri	40		48	40,367	54	51,885	50	25,319
Kansas	14	3,188	13	3,726	17	5,108	15	2,529
Nebraska	5		8		9		8	
Michigan	134	1,349,916	142	1,567,890	165	1,828,870	158	980,742
Wisconsin	106		110		118		116	
South Dakota	1	5	1	9	------	------	------	------
Ohio	232	5,234,787	258	7,013,146	278	7,173,926	276	4,274,412
Total North Central	885	10,875,718	954	14,977,899	1,050	16,086,555	1,028	8,813,826

Consumption of pig iron in the United States, 1935–38, by States and districts—Con.

State and district	1935		1936		1937		1938	
	Consumers	Gross tons	Consumers	Gross tons	Consumers	Gross tons	Consumers	Gross tons
Arizona Nevada New Mexico	3	48	4	72	2	43	1	22
Colorado Utah	17	167,818	16	320,514	15	371,688	17	136,366
Idaho Wyoming Montana	1	6,641	4	2,805	5	482	4	196
Total Rocky Mountain	21	174,507	24	323,391	22	372,213	22	136,584
Oregon Washington	15 35	6,858	16 35	8,223	18 41	6,810	18 33	4,927
California	79	101,227	90	137,266	94	151,959	90	88,464
Total Pacific Coast	129	108,085	141	145,489	153	158,769	141	93,391
Total United States	2,098	20,620,463	2,265	30,098,634	2,440	34,056,527	2,396	18,504,349

World production.—World production of pig iron (including ferro-alloys) in 1938 decreased 20 percent from 1937 and was 4 percent below the 1925–29 average (86,000,000 metric tons). Of the 1938 total the United States supplied 24 percent compared with 36 percent in 1937. Thus, while American production decreased 48 percent, that for the rest of the world decreased only 4 percent.

Pig iron (including ferro-alloys) produced, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
Australia [2]	500,000	630,000	690,000	700,000	700,000
Belgian Congo				565	[2] 600
Belgium	2,952,520	3,029,600	3,161,340	3,803,750	2,464,800
Brazil	56,924	64,082	78,418	98,108	[2] 100,000
Canada	441,916	667,028	766,625	996,671	770,594
China	631,440	607,949	633,434	[2] 600,000	[2] 600,000
Chosen	210,808	245,196	216,752	168,344	[2] 200,000
Czechoslovakia	600,324	810,938	1,139,886	1,675,064	1,233,987
Finland	7,577	11,035	13,107	11,258	27,000
France	6,142,135	5,789,780	6,230,420	7,916,000	6,049,000
Germany	8,716,739	[3] 12,846,241	[3] 15,303,179	[3] 15,959,806	[4] 18,596,000
Austria	133,492	193,170	248,111	389,118	(5)
Saar	1,825,670	[6] 302,196	(3)	(3)	(3)
Hungary	140,220	185,883	306,290	357,935	335,000
India, British	1,347,024	1,489,216	1,568,089	1,655,451	1,560,000
Italy	581,455	703,833	828,484	868,946	927,604
Japan	1,772,380	1,964,613	2,072,445	[2] 2,500,000	[2] 3,000,000
Luxemburg	1,995,193	1,872,372	1,986,604	2,512,495	1,550,703
Mexico	66,458	64,139	88,032	89,717	[2] 90,000
Netherlands	257,841	253,616	274,883	311,773	266,956
New Zealand	1,358	4,981			
Norway	126,932	130,751	167,357	181,238	[2] 200,000
Philippine Islands	150	[2] 200	[2] 200	[2] 200	[2] 200
Poland	381,587	394,097	581,869	724,296	967,668
Rumania	61,635	81,989	97,095	127,235	[2] 130,000
Spain	372,366	354,776	280,924	193,050	[2] 200,000
Sweden	558,129	612,596	631,736	692,865	662,500
Union of South Africa	130,493	173,725	202,186	276,236	294,406
U. S. S. R.	10,495,300	12,606,100	14,546,077	14,520,000	15,179,856
United Kingdom	6,064,802	6,527,105	7,844,922	8,629,313	6,871,546
United States	16,398,077	21,715,541	31,571,224	37,749,575	19,474,677
Yugoslavia	32,620	21,793	44,453	41,006	58,458
	63,004,000	74,355,000	91,574,000	103,750,000	82,512,000

[1] In addition to countries listed, pig iron is produced in Chile, but production figures are not available.
[2] Approximate production.
[3] Beginning with March 1935 production of the Saar is included with that of Germany.
[4] Includes Austria and the Saar. [5] Production for Austria included with Germany.
[6] Data for January and February only. Beginning with March 1935 production of the Saar is included with Germany.

FERRO-ALLOYS

Production and shipments.—The production of ferro-alloys was 584,724 gross tons in 1938 compared with 1,008,170 tons in 1937, a decrease of 42 percent. In 1938 ferro-alloys were made at 12 blast-furnace plants, 16 electric-furnace plants, and 3 aluminothermic plants; in addition 3 plants made ferrophosphorus, and 1 plant made ferrosilicon as a byproduct. Of the 1938 total 338,254 tons were made in blast furnaces and 244,161 tons in electric furnaces.

The shipments of all classes of ferro-alloys in 1938 decreased 52 percent in quantity and 51 percent in total value from 1937. Compared with the 5-year average for 1925–29 (715,250 tons), 1938 shipments decreased 35 percent.

Ferro-alloys shipped from furnaces in the United States, 1937–38, by varieties

Variety of alloy	1937		1938	
	Gross tons	Value	Gross tons	Value
Ferromanganese	359,842	$30,696,748	223,720	$19,144,884
Spiegeleisen	134,983	3,969,822	24,939	80,830
Ferrosilicon (7 percent or more silicon)	362,313	17,683,900	163,775	7,999,661
Ferrophosphorus	15,546	1,059,782	6,593	469,940
Ferrotungsten	2,474	6,279,913	484	1,453,227
Other varieties [1]	95,493	26,450,327	[2] 44,601	[2] 12,662,971
	970,651	86,140,492	464,112	41,811,513

[1] Ferrochromium, ferrocolumbium, ferromolybdenum and calcium-molybdenum compounds, ferrotitanium, ferrovanadium, ferrozirconium, silicomanganese, silicospiegeleisen, and zirconium ferrosilicon.
[2] Also includes ferroboron.

Ferromanganese.—Shipments of ferromanganese in 1938 decreased 38 percent from 1937 and were 26 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 $85.58 in 1938 compared with $85.31 in 1937.

The production of ferromanganese in 1938 decreased 35 percent from 1937 and was made at seven blast-furnace plants and one electric-furnace plant compared with six blast-furnace plants and one electric-furnace plant in 1937. In both years the bulk of the output was made in blast furnaces.

Ferromanganese produced in the United States and metalliferous materials consumed in its manufacture, 1934–38

Year	Ferromanganese produced			Materials consumed (gross tons)				Manganese ore used per ton of ferromanganese made (gross tons)
	Gross tons	Manganese contained		Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Gross tons	Foreign	Domestic			
1934	139,171	78.67	109,491	256,980	853	13,933	3,304	1.853
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

The tonnage of manganese ore used per ton of ferromanganese produced decreased in 1938. Of the total manganese ore used in making ferromanganese in 1938, 5.1 percent was mined in the United States, and 94.9 percent came from foreign sources, as shown in the following table:

Quantity and tenor of manganese ore used in manufacture of ferromanganese in the United States, 1937–38

Source of ore	1937		1938	
	Gross tons	Manganese content (percent, natural)	Gross tons	Manganese content (percent, natural)
Africa	150,112	48.36	152,698	48.99
Brazil	112,238	41.43	64,060	41.44
Chile	186	48.92		
Cuba	60,012	47.28	36,295	48.07
India	62,199	50.09	55,965	49.24
U. S. S. R.	313,305	47.79	107,720	47.61
United States	9,444	53.17	22,548	53.20
	707,496	47.13	439,286	47.72

Spiegeleisen.—Shipments of spiegeleisen from domestic furnaces in 1938 decreased 82 percent from 1937. The average value per ton at the furnaces was $32.41 in 1938 compared with $29.41 in 1937. The entire production, which also decreased, was made in blast furnaces. Output in 1938 averaged 20.24 percent manganese. Most of the spiegeleisen was made from domestic ores in 1938, only 317 tons of foreign manganese ore being used.

Ferrosilicon.—Shipments of ferrosilicon in 1938 decreased 55 percent from 1937.

The production of ferrosilicon in 1938 totaled 249,829 gross tons, including 127,759 tons made by blast furnaces, 121,819 tons by electric furnaces, and 251 tons as a byproduct of the manufacture of artificial abrasives in electric furnaces. The silicon content of the production in 1938 ranged from 7 to 95 percent but averaged 26 percent. Most of the raw material used in making ferrosilicon was of domestic origin.

Ferrophosphorus.—Production of ferrophosphorus decreased to 15,842 gross tons containing 24.14 percent phosphorus in 1938 from 21,796 tons containing 21.81 percent phosphorus in 1937, and shipments from furnaces dropped 58 percent. Most of the 1938 output was made in electric furnaces. Ferrophosphorus was made entirely from domestic materials in 1938.

Ferrotungsten.—Shipments of ferrotungsten decreased 80 percent in quantity and 77 percent in total value from 1937. The 1938 shipments contained 78.85 percent (854,577 pounds) tungsten and were valued at $1.70 per pound of contained tungsten. Production totaled 442 gross tons containing 78.91 percent tungsten (781,668 pounds). In addition to domestic ores (chiefly from California, Colorado, and Nevada), foreign ores from China, Malay States, 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 the bulk of the imports in

1937 and 1938. Imports of ferromanganese for consumption (chiefly from Norway and Netherlands) were 26,258 gross tons—11 percent less than in 1937. Imports of spiegeleisen for consumption (chiefly from Canada) were 17,248 tons, an increase of 2 percent over 1937. The duty on ferrosilicon containing 8 percent but less than 30 percent silicon was cut ½ cent to 1 cent per pound of silicon content, effective January 1, 1939, in the new trade agreement with Canada. That country supplies the bulk of the imports of this material.

Ferro-alloys and ferro-alloy metals imported for consumption in the United States, 1937–38, by varieties

Variety of alloy	1937			1938		
	Gross weight (gross tons)	Content (gross tons)	Value	Gross weight (gross tons)	Content (gross tons)	Value
Ferromanganese:						
Containing over 1 percent carbon	28,840	23,286	$2,075,651	26,001	20,903	$1,739,501
Containing not over 1 percent carbon	718	603	87,965	257	215	31,447
Manganese silicon (manganese content)	(1)	35	2,070			
Manganese boron, manganese metal, and spiegeleisen not more than 1 percent carbon (manganese content)	(1)	1	733	(1)	19	8,798
Spiegeleisen	16,841	(1)	589,766	17,248	(1)	625,480
Ferrochrome or ferrochromium:						
Containing 3 percent or more of carbon	164	96	19,066	(2)	(3)	5
Containing less than 3 percent of carbon	248	164	44,744	175	123	29,953
Ferrophosphorus	50	(1)	2,679			
Ferrosilicon	12,930	2,026	349,207	5,325	626	134,067
Chrome or chromium metal	78	(1)	91,014	39	(1)	48,343
Chromium and zirconium silicon and calcium silicide	1,685	(1)	206,415	899	(1)	93,317
Ferromolybdenum, molybdenum metal and powder, calcium molybdate, and other compounds and alloys of molybdenum (molybdenum content)	(1)	3	13,491	(1)	(4)	81
Ferrotitanium	2	(1)	608			
Tungsten and combinations, in lumps, grains, or powder:						
Tungsten metal (tungsten content)	(1)	59	125,569	(1)	9	23,994
Tungsten carbide (tungsten content)	(1)	1	4,369			
Combinations containing tungsten or tungsten carbide (tungsten content)	(1)	(5)	1,975	(1)	1	7,523
Tungsten acid and other compounds of tungsten, n. s. p. f. (tungsten content)	(1)	(6)	1,661	(1)	(7)	1,606

[1] Not recorded.
[2] 100 pounds.
[3] 60 pounds.
[4] 25 pounds.
[5] 379 pounds.
[6] 522 pounds.
[7] 241 pounds.

Ferromanganese and ferrosilicon imported for consumption in the United States, 1937–38, by countries

Country	Ferromanganese (manganese content)				Ferrosilicon (silicon content)			
	1937		1938		1937		1938	
	Gross tons	Value	Gross tons	Value	Gross tons	Value	Gross tons	Value
Canada	3,385	$426,759			1,532	$303,391	626	$134,067
Czechoslovakia	944	57,919	3,043	$211,356				
France	760	101,901	1,137	152,068				
Italy	43	5,706						
Japan	722	84,698	308	37,118				
Netherlands	282	17,033	5,843	403,561				
Norway	17,468	1,447,177	10,547	953,045	475	43,335		
Poland and Danzig	156	9,897						
United Kingdom	128	12,526			19	2,481		
Yugoslavia			240	13,800				
	23,888	2,163,616	21,118	1,770,948	2,026	349,207	626	134,067

Exports of ferro-alloys, which are relatively unimportant from a tonnage standpoint, decreased in 1938 from 1937. Exports of ferromanganese and spiegeleisen in 1938 were 247 gross tons and of other ferro-alloys 1,197 tons.

Ferro-alloys and ferro-alloy metals exported from the United States, 1937–38, by varieties

Variety of alloy	1937		1938	
	Gross tons	Value	Gross tons	Value
Ferromanganese and spiegeleisen	1,725	$72,502	247	$18,799
Other ferro-alloys [1]	2,780	2,201,968	1,197	1,171,869

[1] Includes ferrosilicon, ferrotungsten, ferrovanadium, and other ferro-alloys.

STEEL

Production.—Reversing the trend in 1937, when the rate of operation dropped from 81 percent of capacity in January to 25 percent in December, activities in steel production increased during 1938 but did not entirely recover the ground lost during the last quarter of 1937. The opening of 1938 found operations at a very low level, and during the first half the operating rate was only 31 percent of capacity compared with 85 percent during the first half of 1937. The best month's operation in 1938 was November, when 62 percent of the capacity was employed; during the last quarter of the year the operating rate was about 56 percent of capacity. The following figures covering the output of steel were compiled by the American Iron and Steel Institute. Production of steel ingots and castings in 1938 totaled 28,349,991 gross tons, the lowest since 1934, 43 percent below the 1925–29 average, and a decrease of 44 percent below 1937.

Of the 1938 total, 91.6 percent was made in the open hearth, 6.6 percent in bessemer converters, 1.8 percent in electric furnaces, and only 6 tons in crucible furnaces. The bulk (25,691,963 tons) of the total open-hearth output in 1938 was made in basic furnaces.

Of the total output of steel ingots and castings 28,210,841 gross tons were ingots in 1938 compared with 50,318,151 tons in 1937.

A large part of the steel production comes from the contiguous States—Pennsylvania and Ohio. In 1938 these two States produced about 50 percent of the total steel, 48 percent of the open-hearth steel, and 77 percent of the bessemer steel.

Open-hearth steel ingots and castings manufactured in the United States, 1934–38, by States, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

State	1934	1935	1936	1937	1938
New England States	209,527	248,778	301,161	276,021	163,658
New York and New Jersey	1,086,189	1,275,496	2,109,946	2,789,413	1,347,802
Pennsylvania	6,477,890	7,850,710	12,913,903	14,561,700	7,072,157
Ohio	5,649,785	7,702,018	9,789,985	9,067,944	5,372,234
Indiana	3,098,343	4,376,998	5,963,501	5,947,368	3,435,360
Illinois	1,642,437	2,534,811	3,663,011	3,913,318	1,950,224
Other States	5,366,934	6,726,618	8,794,621	9,716,539	6,622,865
	23,531,105	30,715,429	43,536,128	46,272,303	25,964,300

Bessemer-steel ingots and castings manufactured in the United States, 1934–38, by States, in gross tons

[Includes only that portion of the steel for castings produced in foundries operated by companies manufacturing steel ingots]

<table>
<tr><th>State</th><th>1934</th><th>1935</th><th>1936</th><th>1937</th><th>1938</th></tr>
<tr><td>Ohio</td><td>1,017,629</td><td>1,361,933</td><td>1,639,329</td><td>1,747,710</td><td>1,074,032</td></tr>
<tr><td>Pennsylvania</td><td>570,817</td><td>764,403</td><td>952,971</td><td>830,440</td><td>348,060</td></tr>
<tr><td>Illinois</td><td>299,157</td><td>375,445</td><td rowspan="2">866,157</td><td rowspan="2">871,777</td><td rowspan="2">458,569</td></tr>
<tr><td>Other States</td><td>274,754</td><td>333,250</td></tr>
<tr><td></td><td>2,162,357</td><td>2,835,031</td><td>3,458,457</td><td>3,449,927</td><td>1,880,661</td></tr>
</table>

Steel electrically manufactured in the United States, 1934–38, 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
1934	349,095	12,201	361,296	1937	814,310	31,227	845,537
1935	521,818	19,674	541,492	1938	468,610	36,414	505,024
1936	704,213	68,242	772,455				

The steel-production figure for 1938 includes 1,476,348 gross tons of alloy-steel ingots and castings, which represent 5 percent of the total. The 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. Output of alloy steels in 1938 decreased 51 percent from 1937, whereas that of total steel decreased 44 percent. Of the total alloy-steel output in 1938, 71 percent came from basic open hearths, 6 percent from acid open hearths, 23 percent from electric furnaces, 4 tons from crucible furnaces, and 12 tons from bessemer furnaces.

Production of alloy-steel ingots and castings, 1935–38, 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
Open hearth, basic	1,633,541	2,239,885	2,285,000	1,052,706
Open hearth, acid	73,400	115,766	146,835	91,151
Bessemer	----------	----------	----------	12
Crucible	154	209	241	4
Electric	412,563	527,762	600,550	332,475
	2,119,658	2,883,622	3,032,626	1,476,348

From the foregoing tables it will be seen that the bulk (66 percent in 1938) of the steel made in the electric furnace is alloy steel. Typically, steels with higher alloy content are made in the electric furnace, and steels with lower alloy content are made by the open-hearth process.

Foreign trade.—Although exports of iron and steel products (excluding scrap) in 1938 were lower than in 1937 they were higher than in any other year since 1929. The volume of export business was off about one-third from the high figure established in 1937, when abnormal demands in foreign markets caused an abrupt rise in shipments. Because of unsettled conditions and expanded armament activities foreign producers were unable to meet demands in their own countries, and buyers 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 caused abnormal exports in a wide range of semimanufactured and manufactured American products. This situation, however, is being rectified by the construction and equipment of new plants and the search for and development of raw material sources. 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 items in this report. All important items in the 1938 movement of iron and steel products registered declines. Exports of iron and steel scrap (including tin-plate scrap), though lower than the unprecedented total of 4,101,549 tons in 1937, were high, amounting to 2,998,607 tons. Of the 1938 scrap exports 60 percent went to Japan (46 percent) and Italy (14 percent).

Although exports of American iron and steel products in 1938 reached most of the world's markets Japan was the outstanding purchaser, taking about one-fourth of the total (exclusive of scrap). Canada, United Kingdom, and the Philippines followed Japan in order as the principal takers of American iron and steel in 1938.

Iron and steel exported from the United States, 1937–38

Article	1937		1938	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel ingots, blooms, billets, slabs, and sheet bars	338,722	$13,391,372	167,641	$5,905,201
Iron and steel bars and rods:				
Iron bars	2,220	191,885	1,310	100,803
Concrete reinforcement bars	17,899	1,072,617	26,105	1,366,775
Other steel bars	139,138	10,088,002	123,417	8,873,068
Wire rods	60,008	3,262,955	23,465	1,381,414
Iron and steel plates, sheets, skelp, and strips:				
Boiler plates	10,450	717,441	6,753	460,613
Other plates, not fabricated	376,369	20,789,171	214,355	10,883,283
Skelp iron or steel	76,478	3,506,898	59,867	2,465,104
Iron and steel sheets, galvanized	81,019	7,470,012	76,037	7,020,398
Steel sheets, black, ungalvanized	286,510	24,013,717	205,278	16,442,444
Iron sheets, black	10,787	935,046	7,566	614,633
Strip band, and scroll iron or steel:				
Cold-rolled	36,323	3,850,052	25,514	2,714,356
Hot-rolled	74,911	4,129,168	37,041	2,469,958
Tin plate, terneplate, and taggers' tin	360,683	39,939,922	161,576	19,078,015
Manufactures—steel-mill products:				
Structural iron and steel:				
Water, oil, gas, and other storage tanks complete and knocked-down material	44,578	3,550,576	37,730	3,284,095
Structural shapes:				
Not fabricated	135,706	6,984,169	83,691	4,507,428
Fabricated	39,129	3,911,864	38,057	3,666,049
Plates fabricated, punched, or shaped	25,221	1,507,473	2,348	219,003
Metal lath	1,751	287,430	863	160,272
Frames, sashes, and sheet piling	9,193	748,710	4,909	519,986

Iron and steel exported from the United States, 1937–38—Continued

Article	1937 Gross tons	1937 Value	1938 Gross tons	1938 Value
Manufactures—steel-mill products—Continued.				
Railway track material:				
Rails for railways	148,182	$5,166,782	82,721	$3,111,734
Rail joints, splice bars, fishplates, and tieplates	14,582	964,583	7,343	444,081
Switches, frogs, and crossings	2,555	466,596	1,645	325,514
Railroad spikes	3,073	218,842	2,606	186,529
Railroad bolts, nuts, washers, and nut locks	1,112	184,472	1,236	148,132
Tubular products:				
Boiler tubes	17,458	2,784,812	8,124	1,541,236
Casing and oil-line pipe	83,481	8,302,479	63,703	6,916,700
Seamless black pipe, other than casing and oil line	12,482	1,507,134	7,459	1,286,813
Welded black pipe	25,873	2,517,972	13,779	1,407,519
Welded galvanized pipe	20,558	2,020,902	17,404	1,762,457
Malleable-iron screwed pipe fittings	5,385	1,596,924	3,102	1,088,644
Cast-iron screwed pipe fittings	2,964	752,531	1,891	506,202
Cast-iron pressure pipe and fittings	20,611	1,092,658	20,045	1,312,048
Cast-iron soil pipe and fittings	7,601	498,395	9,957	656,704
Riveted-steel or iron pipe and fittings	980	137,421	945	189,307
Wire and manufactures:				
Barbed	33,834	2,592,812	33,942	2,457,339
Galvanized wire	22,958	1,974,567	25,792	1,946,316
Iron or steel wire, uncoated	33,141	2,837,389	24,080	1,830,283
Wire rope, and strand	7,824	1,841,341	4,372	1,181,125
Woven-wire fencing and screen cloth	4,749	924,247	3,541	682,452
All other	9,082	2,060,860	6,262	1,504,675
Nails and bolts (except railroad):				
Wire nails	17,408	1,312,961	20,720	1,369,771
Horseshoe nails	975	208,805	888	179,128
All other nails, including tacks and staples	3,508	450,984	4,348	476,580
Bolts, nuts, rivets, and washers (except railroad)	11,166	2,749,617	8,057	2,082,898
Castings and forgings:				
Horseshoes and calks	179	20,802	103	13,114
Iron and steel, including car wheels and axles	51,371	5,759,688	37,634	4,536,947
Advanced manufactures:				
House heating boilers and radiators		428,957		333,101
Oil burners and parts		1,305,648		1,125,993
Tools:				
Axes		868,300		476,610
Shovels and spades		276,232		248,392
Hammers and hatchets		372,383		232,008
Saws, wood and metal cutting		1,746,366		1,225,686
All other tools		12,109,554		9,356,596

Imports for consumption of iron and steel (exclusive of scrap) in 1938 were the lowest since 1921 and amounted to about half of the 1937 volume. The import trade was much lower than the export trade. Declines were recorded throughout the list, and while ferromanganese and spiegeleisen held up fairly well pig iron dropped sharply. Structural shapes, pipes, and bars were imported in largest quantities among the manufactured and unmanufactured articles in 1938, but all were received in much smaller quantities than in 1937. Imports came principally from European countries, Canada, and British India. Imports of scrap in 1938 amounted to only 24,451 long tons (70 percent below 1937), and 97 percent of the 1938 total came from Canada.

Iron and steel imported for consumption in the United States, 1937–38, by commodities

Commodity	1937		1938	
	Gross tons	Value	Gross tons	Value
Semimanufactures:				
Steel bars:				
Concrete reinforcement	3,894	$114,082	1,531	$51,924
Solid or hollow, n. e. s	44,191	2,268,840	18,899	1,122,228
Hollow and hollow drill steel	2,537	357,491	865	131,386
Iron slabs, blooms, or other forms	1	33	(1)	5
Bar iron	1,956	141,661	504	29,005
Wire rods, nail rods, and flat rods up to 6 inches in width	15,819	1,361,466	5,280	410,454
Boiler or other plate iron or steel, except crucibles and saw-plate steel	204	8,105	355	18,900
Sheets or plates of iron or steel	9	2,034	(1)	17
Steel ingots, blooms, and slabs	130	4,612	205	5,586
Billets, solid or hollow	2,077	223,268	553	65,413
Die blocks or blanks; shafting, etc	102	38,630	96	34,191
Circular saw plates	27	11,624	32	14,233
Sheets of iron or steel, common or black and boiler or other plate iron or steel	6,766	274,481	5,651	290,289
Sheets and plates and steel, n. s. p. f	2,007	97,211	361	29,634
Tin plate, terneplate, and taggers' tin	246	71,764	109	32,013
Manufactures:				
Structural iron and steel	78,273	2,597,657	39,624	1,494,869
Rails for railways	7,891	219,109	3,336	98,020
Rail braces, bars, fishplates or splice bars and tie plates	407	20,639	288	14,935
Pipes and tubes:				
Cast-iron pipe and fittings	3,698	209,886	1,619	59,420
Other pipes and tubes	42,486	3,955,212	29,102	2,481,334
Wire:				
Barbed	16,666	867,809	12,528	720,378
Round iron and steel	4,612	839,725	1,531	308,223
Bailing	254	13,342	152	10,170
Telegraph, telephone, etc., except copper, covered with cotton jute, etc	34	10,384	27	14,144
Flat and steel strips not thicker than ¼-inch and not over 16 inches wide	4,033	2,136,754	2,696	1,616,961
Rope and strand	3,548	549,393	2,020	376,406
Galvanized fencing wire and wire fencing	3,250	161,834	1,459	96,865
Hoop or band iron or steel for baling	1,611	76,727	9,403	406,246
Hoop, band, strips, or scroll iron or steel, n. s. p. f	25,618	896,377	16,728	644,974
Nails	15,032	1,086,633	7,598	649,898
Castings and forgings, n. e. s	4,586	591,721	3,815	427,788

[1] Less than 1 ton.

MANGANESE AND MANGANIFEROUS ORES

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

Demand for manganese ore was less in 1938 than in 1937 owing to a recession in the rate of world steel production, and imports into all large consuming countries decreased. High stocks on hand in some consuming countries, notably the United States, at the beginning of the year and curtailed activities in consuming outlets, materially reduced the volume of business. In consequence, prices slumped heavily as the year progressed.

Despite the sharp drop in imports in 1938 (47 percent below 1937), stocks of ore in bonded warehouses increased sharply and established a new year-end peak. As most of the domestic requirement is supplied by imports, the apparent consumption of manganese ore reflected the drop in imports for consumption. Although the small domestic production decreased, it was stimulated by Navy purchases of ferromanganese which required that the ferro-alloy be made from domestic ores. Two furnaces, one at Reusens, Va., and the other at Minnequa, Colo., supplied the total (largely from Montana ore). The higher rate of steel activity in the Birmingham district compared with other producing centers benefited producers of manganese ore in the Southeastern States.

Salient statistics of the manganese industry in the United States, 1925–29 (average) and 1934–38, in long tons

	1925–29 (average)	1934	1935	1936	1937	1938
Manganese ore:						
Total shipments containing 35 percent or more Mn	59,312	26,514	26,428	32,119	40,241	25,321
Shipments of metallurgical ore	[1] 41,892	14,978	16,679	18,557	26,419	16,989
Shipments of battery ore	17,420	8,889	7,264	7,747	6,447	4,959
Imports for consumption	600,000	341,338	383,500	813,362	911,919	483,588
Stocks in bonded warehouses at end of year	304,000	430,714	418,302	366,381	681,290	842,048
Indicated consumption (35 percent or more Mn)	659,000	369,563	413,286	848,491	954,503	509,932
Ferro-alloys:						
Production of ferromanganese	306,360	139,171	214,290	316,000	376,443	242,994
Imports of ferromanganese [2] [3]	[4] 50,590	18,702	21,830	30,593	23,888	21,118
Production of spiegeleisen	95,463	([5])	60,018	95,137	([5])	11,311
Imports of spiegeleisen [2]	7,298	21,184	32,384	52,011	16,841	17,248
Exports of spiegeleisen and ferromanganese	3,769	222	131	466	1,725	247
Stocks of ferromanganese in bonded warehouses	[3] [4] 7,765	7,124	5,796	9,902	11,788	8,392

[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.

[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 Bureau of Mines continued experimental work on the process for the production of pure electrolytic manganese.[2] A license to use the procedure was issued in 1938,[3] and a small pilot plant was under construction at Knoxville, Tenn.

The trend of imports and domestic production of manganese ore is shown graphically in figure 1.

Strategic reserve.—In connection with its purchases of certain strategic commodities, the Navy Department issued specifications and called for bids on manganese ore with alternate bids on low-grade

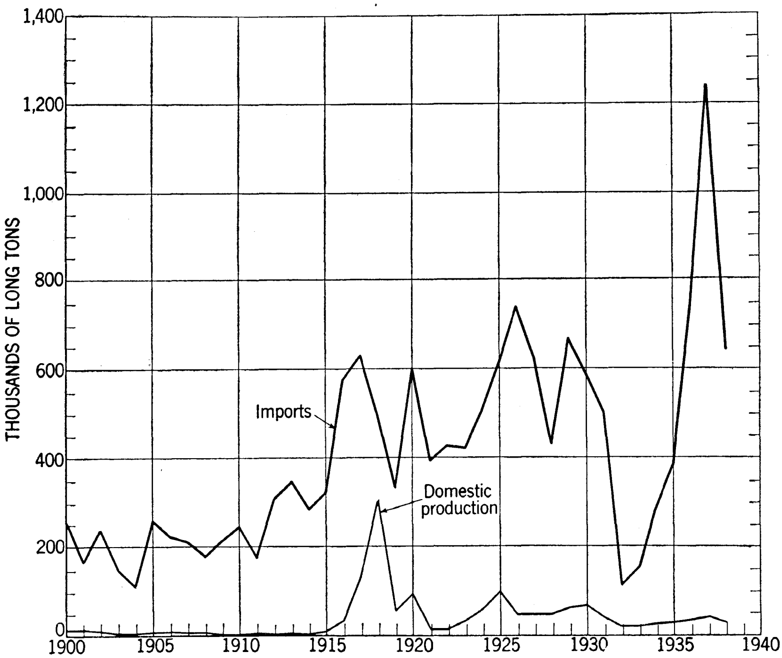

FIGURE 1.—Imports and domestic production of manganese ore, 1900–1938. Statistics on imports shown in the graph represent "general imports" for the period 1900–1933; beginning with 1934 data classified as "general imports" were not available, and the figures plotted for 1934–38 represent imports for consumption adjusted for changes in stocks in bonded warehouses and are closely comparable with the record for earlier years.

ferromanganese, on October 29, 1937. All were rejected, however, because the material specified was not considered satisfactory, and the specifications were reconsidered. Later (March 18, 1938) bids on standard-grade ferromanganese were called for. Early in April two contracts were let—one to E. J. Lavino & Co. for 6,000 long tons at $110.50 per long ton at the Philadelphia Navy Yard and the other to the Colorado Fuel & Iron Corporation for 5,500 long tons at $105 per long ton f. o. b. plant at Minnequa, Colo. The contracts were completed during the year.

These purchases were made from a limited appropriation of the Navy Department for stockpiles of strategic commodities. Legisla-

[2] Shelton, S. M., Royer, M. B., and Towne, A. P., Electrolytic Manganese. Progress Report 23—Metallurgical Division: Bureau of Mines Rept. of Investigations 3406, 1938, pp. 3–16.
Dean, R. S., and others, Annual Report of the Metallurgical Division, Fiscal Year 1937–38. Progress Report 25—Metallurgical Division: Bureau of Mines Rept. of Investigations 3419, 1938, pp. 13–20.

[3] Shelton, S. M., Electrolytic Process for the Extraction of Metallic Manganese: United States Patent 2,119,560, June 7, 1938.

tion providing the purchase of much larger quantities has been given serious consideration in the past few years, and bills passed both houses of Congress early in 1939. The following tables present data that may be of interest in studying the strategic position of manganese ore.

Domestic shipments of manganese ore, imports of manganese and ferromanganese, and apparent consumption of manganese metal, 1910–38, in long tons

Year	Manganese ore			Imports of ferro-manganese (gross weight)	Apparent consumption of manganese metal [1]	
	Domestic shipments		Imports		Quantity	Percent from domestic sources
	10 to 35 percent Mn	35 percent or more Mn				
1910	(2)	2,258	242,348	114,228	(3)	------------
1911	[4] 2,602	2,457	176,852	80,263	(3)	------------
1912	[4] 2,782	1,664	300,661	99,137	(3)	------------
1913	[4] 9,650	4,048	345,090	128,070	217,658	4.1
1914	[4] 60,484	2,635	283,294	82,997	162,112	7.5
1915	[4] 64,204	[4] 9,558	320,778	55,263	179,266	13.2
1916	[4] 316,600	31,474	576,321	90,928	283,944	15.6
1917	[4] 576,608	[4] 129,351	629,972	41,969	271,770	22.7
1918	[4] 818,003	305,869	491,303	27,168	297,303	35.2
1919	[4] 211,632	[4] 54,957	333,344	33,022	162,378	31.7
1920	[4] 357,279	94,420	599,764	59,254	278,952	16.5
1921	[4] 8,439	13,531	392,606	9,077	96,104	16.0
1922	[4] 344,674	[4] 13,404	425,000	[5] 100,725	211,714	6.3
1923	[4] 319,666	[4] 31,500	419,000	[5] 113,833	309,254	9.7
1924	[4] 286,470	[4] 56,515	505,000	[5] 56,588	230,264	9.9
1925	[4] 267,252	98,324	615,000	[5] 78,713	280,725	8.6
1926	[4] 364,312	46,258	738,000	[5] 59,710	316,308	8.0
1927	[4] 148,291	44,741	622,067	[5] 45,500	291,206	9.4
1928	[4] 90,581	46,860	427,708	[5] 60,055	320,496	10.4
1929	78,191	60,379	664,269	[5] 71,211	356,079	9.3
1930	77,417	67,035	585,568	[5] 55,046	280,130	9.2
1931	64,062	39,242	502,518	24,664	166,492	(6)
1932	15,635	17,777	110,634	18,470	67,673	14.4
1933	12,779	19,146	156,836	39,693	150,379	3.4
1934	23,231	26,514	341,339	23,349	(6)	(6)
1935	93,291	26,428	383,500	27,240	210,784	4.8
1936	98,962	32,119	813,362	37,953	310,497	4.1
1937	151,955	40,241	911,922	29,559	(6)	(6)
1938	33,620	25,321	483,588	26,258	217,961	6.1

[1] In ferromanganese and spiegeleisen.
[2] Fluxing ore only.
[3] Data not available.
[4] Exclusive of fluxing ore.
[5] Manganese content reported from Sept. 22, 1922, through 1930; gross weight calculated.
[6] Bureau of Mines not at liberty to publish figures.

Manganese ore (35 percent or more Mn) produced and shipped in the United States, 1910–38, by States, in long tons

Year	Alabama	Arizona	Arkansas	California	Colorado	Georgia	Idaho	Montana	Nevada
1910	-	-	500	-	-	-	-	-	-
1911	-	-	-	2	-	-	-	-	-
1912	-	-	-	19	-	-	-	-	-
1913	-	-	-	-	-	-	-	-	-
1914	-	-	-	501	-	-	-	-	-
1915	200	339	1,288	2,563	150	3,168	-	-	-
1916	27	3,060	6,318	6,136	110	1,572	-	6,418	309
1917	264	14,802	10,140	14,196	[1] 60	3,614	-	61,109	3,450
1918	709	17,612	7,731	24,067	4,821	6,679	-	199,932	19,872
1919	40	[1] 529	2,558	11,289	11,166	48	-	24,993	[1] 78
1920	57	2,402	3,445	1,733	3,643	341	-	76,441	1,240
1921	-	328	728	-	490	-	-	11,129	-
1922	-	203	2,264	255	-	-	-	[1] 9,751	18
1923	24	245	3,768	355	2,278	1,502	-	[1] 21,916	-
1924	1,242	42	3,400	850	5,338	1,093	-	[1] 35,445	1,310
1925	938	294	3,517	869	743	1,649	-	76,188	850
1926	896	2,684	2,450	393	-	3,251	830	23,617	1,607
1927	687	3,905	2,605	-	84	489	3,181	26,506	1,357
1928	421	3,507	3,623	-	-	4,727	1,345	26,733	-
1929	-	2,655	4,308	569	-	2,521	1,326	42,327	-
1930	-	364	3,276	162	-	18,897	-	35,605	1,489
1931	-	40	4,028	40	-	6,491	-	25,812	-
1932	267	-	1,306	-	-	200	-	15,479	-
1933	806	-	1,890	-	-	1,565	-	9,320	-
1934	-	-	5,842	158	-	6,281	-	11,548	-
1935	185	-	3,809	306	-	6,960	-	10,823	-
1936	572	-	4,557	-	-	3,821	-	16,456	-
1937	289	-	3,931	-	-	689	-	26,744	-
1938	202	-	2,987	-	-	3,058	-	11,936	43

Year	New Mexico	Tennessee	Texas	Utah	Virginia	Washington	Other States [2]	United States
1910	-	-	-	-	1,758	-	-	2,258
1911	-	-	-	-	2,455	-	-	2,457
1912	-	-	-	-	1,537	-	108	1,664
1913	-	-	-	-	4,048	-	-	4,048
1914	-	-	-	-	1,724	-	410	2,635
1915	-	150	50	[1] 30	1,620	-	-	[1] 9,558
1916	506	429	800	1,282	4,417	90	-	31,474
1917	2,603	1,996	25	4,195	12,360	-	537	[1] 129,351
1918	3,126	4,162	380	5,100	10,928	-	750	305,869
1919	-	328	-	-	3,928	-	-	[1] 54,957
1920	2,053	502	-	-	2,523	-	40	94,420
1921	-	139	-	-	717	-	-	13,531
1922	-	113	-	-	800	-	-	[1] 13,404
1923	179	213	-	-	987	-	33	[1] 31,500
1924	775	455	-	-	1,565	5,000	-	[1] 56,515
1925	1,588	352	-	50	3,121	8,113	52	98,324
1926	1,966	1,555	-	-	3,792	3,162	55	46,258
1927	2,190	498	-	27	3,212	-	-	44,741
1928	2,627	55	-	-	3,812	-	10	46,860
1929	2,969	523	42	88	3,051	-	-	60,379
1930	2,574	508	247	-	3,853	-	60	67,035
1931	1,072	70	155	-	1,505	-	29	39,242
1932	-	-	-	-	525	-	-	17,777
1933	-	588	-	-	4,882	-	95	19,146
1934	-	1,088	-	-	1,597	-	-	26,514
1935	-	1,893	-	-	2,452	-	-	26,428
1936	-	3,539	-	1,635	1,361	-	178	32,119
1937	878	3,575	38	32	2,265	-	1,800	40,241
1938	560	4,130	-	-	2,242	-	163	25,321

[1] Exclusive of fluxing ore.
[2] Massachusetts, New Jersey, North Carolina, Oklahoma, Oregon, South Carolina, South Dakota, West Virginia, and Wyoming.

DOMESTIC PRODUCTION

The domestic production (shipments from domestic mines) of manganese ore decreased 37 percent in 1938 from 1937. Of the manganese ore shipped to metallurgical plants in 1938, 5,356 long tons contained (natural) 48 percent or more Mn.

Manganiferous raw materials shipped by producers in the United States, 1934–38, 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		
1934	14, 978	23, 231	198, 591	65, 236	8, 889	2, 647
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

Shipments of the various grades 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, Montana, Nevada, Tennessee, Virginia, and West Virginia.

Metallurgical manganese ore shipped from mines in the United States, 1934–38, by States, in long tons

State	1934	1935	1936	1937	1938	State	1934	1935	1936	1937	1938
Alabama	------	59	377	31	111	Texas	------	------	------	38	------
Arkansas	5, 842	3, 809	4, 557	3, 931	2, 987	Utah	------	------	1, 635	32	------
California	158	306	------	------	------	Virginia	1, 040	1, 972	196	952	1, 314
Georgia	6, 281	6, 960	3, 821	689	3, 058	West Virginia	------	------	138	1, 800	56
Montana	1, 657	2, 155	5, 154	16, 854	5, 300						
New Mexico	------	------	------	878	560		14, 978	16, 679	18, 557	26, 419	16, 989
Tennessee	------	1, 418	2, 679	1, 214	3, 603						

Ferruginous manganese ore shipped from mines in the United States, 1934–38, by States, in long tons

State	1934	1935	1936	1937	1938	State	1934	1935	1936	1937	1938
Alabama	1, 404	647	540	279	356	Nevada	------	------	------	533	------
Arkansas	1, 374	145	3, 285	7, 509	3, 477	New Mexico	------	------	170	18, 581	6, 093
Colorado	------	2, 625	10, 568	11, 577	655	Tennessee	------	------	104	902	456
Georgia	9, 166	3, 735	2, 717	4, 045	2, 807	Utah	------	190	2, 974	3, 436	------
Massachusetts	------	------	------	------	230	Virginia	40	645	874	1, 170	1, 670
Michigan	------	555	9, 627	------	------						
Minnesota	------	77, 931	47, 796	84, 263	17, 424		23, 231	93, 291	98, 962	151,955	33, 620
Montana	11, 247	6, 818	20, 307	19, 660	452						

Manganiferous iron ore shipped from mines in the United States, 1934–38, by States, in long tons

State	1934	1935	1936	1937	1938
Alabama	------------	------------	------------	149	------------
Colorado	------------	56	------------	------------	------------
Georgia	31	------------	427	5, 492	------------
Michigan	595	4, 847	------------	9, 739	16, 057
Minnesota	197, 622	419, 373	840, 725	1, 173, 637	259, 183
Wisconsin	343	6, 617	405	------------	------------
	198, 591	430, 893	841, 557	1, 189, 017	275, 240

Further details for 1938, by States, are given in the following table.

Manganese and manganiferous ores shipped by mines in the United States in 1938, 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] 1	111	$1,324	3	356	$2,797			
Arkansas	2	2,987	(2)	2	3,477	(2)			
Colorado				2	655	(2)			
Georgia	5	3,058	46,443	7	2,807	12,057			
Massachusetts				1	230	(2)			
Michigan							1	16,057	$700,776
Minnesota				2	17,424	(2)	3	259,183	
Montana	[1] 1	5,300	(2)	2	452	1,971			
New Mexico	1	560	(2)	2	6,093	(2)			
Tennessee	[1] 3	3,603	60,829	3	456	3,228			
Virginia	[1] 8	1,314	21,588	7	1,670	15,502			
West Virginia	[1] 1	56	966						
Undistributed			247,366			122,025			
Total metallurgical	22	16,989	378,516	31	33,620	157,580	4	275,240	700,776
Battery: Montana	[1, 3] 2	4,959	234,436						
Miscellaneous:									
Alabama	[1] 1	91	1,706						
Montana	[1] 3	1,677	31,897						
Nevada	1	43	416						
Tennessee	[1] 3	527	16,977						
Virginia	[1] 10	928	16,227						
West Virginia	[1] 1	107	1,504						
Total miscellaneous	19	3,373	68,727						
	32	25,321	681,679	31	33,620	157,580	4	275,240	700,776

[1] 1 producer in Alabama, 1 in Montana, 2 in Tennessee, 5 in Virginia, and 1 in West Virginia shipped both metallurgical and miscellaneous ore, and 1 in Montana shipped both battery and miscellaneous ore.
[2] Included under "Undistributed."
[3] Mills through which all ore was shipped; producers not counted.

Alabama.—All shipments of manganese ore from Alabama in 1938 were made by J. B. Bynum, who operates the Walnut Grove mine at Walnut Grove, Etowah County. The ore shipped to metallurgical plants (111 long tons) averaged (natural) 36.33 percent Mn, while that shipped for miscellaneous uses ran (natural) 74.01 percent MnO_2. Shipments of ferruginous manganese ore came from Calhoun and Etowah Counties and averaged (natural) 27.53 percent Mn. No manganiferous iron ore was shipped in 1938.

Arizona.—Although no production was recorded in Arizona in 1938, exploration work in the area near Artillery Peak, Mohave County, was continued during the year.

Arkansas.—Two shippers, Walter H. Denison and A. B. Reither, supplied the Arkansas total (2,987 long tons) of manganese ore in 1938 from operations in the Batesville-Cushman district in Independence County. The ore averaged (natural) 45.10 percent Mn. In addition, they shipped the entire output of ferruginous manganese ore (3,477 tons). The ferruginous manganese ore averaged (natural) 22.98 percent Mn.

Colorado.—No manganese ore was shipped from Colorado in 1938, but 655 long tons of ferruginous manganese ore were shipped from two operations. The bulk of the total came from the King-United mine in San Juan County and contained (natural) 32.5 percent Mn and 20.2

percent iron. This property is reported to have closed in October. The remainder came from the Pershing mine in Saguache County and contained (natural) 21.6 percent Mn and 9.2 percent iron.

Georgia.—Aside from 1 small carload from McDuffie County near Littleton, which contained (natural) 41.41 percent Mn, all manganese ore from Georgia in 1938 came from four shippers in the Cartersville district in Bartow County, of which the White Manganese Corporation supplied the larger part. The manganese ore from Georgia averaged (natural) 38.91 percent Mn and was shipped to Birmingham, Ala. The Cartersville district likewise supplied the bulk (2,738 long tons) of the Georgia shipments of ferruginous manganese ore which averaged (natural) 16.85 percent Mn. Shipments of 69 tons of ore, which ran (natural) 22.83 percent Mn, were also reported from the Gibson mine in Floyd County. No manganiferous iron ore was shipped from Georgia in 1938, but shipments of untreated iron ore which contained up to 5 percent Mn were continued during 1938. This ore is mined cheaply from small open-cuts and shipped by rail to Birmingham.

Massachusetts.—Shipments of ferruginous manganese ore from Massachusetts in 1938, the first in several years, totaled 230 long tons containing (natural) 27 percent Mn and 3 percent iron. The ore came from the Taconic mine in Hampshire County.

Michigan.—The Eureka mine in Iron County supplied the manganiferous iron ore shipped from Michigan in 1938. The ore averaged (natural) 5.61 percent Mn and 47.25 percent iron.

Minnesota.—All shipments of manganese-bearing ores from Minnesota in 1938 came from the Cuyuna range in Crow Wing County. Of the ferruginous manganese ore shipped in 1938, 16,698 long tons containing (natural) 17.40 percent Mn and 31.67 percent iron came from the Merritt mine, while 726 tons containing (natural) 16.86 percent Mn and 28.39 percent iron came from the Mangan mine. Five properties—the Alstead-Hillcrest, the Hopkins, the Louise, the Sagamore, and the Mahnomen—supplied the shipments of manganiferous iron ore from Minnesota in 1938. The ore averaged (natural) 7.52 percent Mn and 35.84 percent iron.

Montana.—Shipments of manganese ore from Montana in 1938 decreased 55 percent from 1937. Of the total, 44 percent was nodulized rhodochrosite from the Emma mine at Butte, which averaged (dried) 59.25 percent Mn, while 42 percent was battery-grade concentrates from the Philipsburg district, which averaged (natural) about 70 percent MnO_2. Ores for miscellaneous uses were shipped from both districts. Shipments of ferruginous manganese ore consisted of 133 tons of rhodochrosite from the Emma mine containing (natural) 33.06 percent Mn and 319 tons of tailings containing (dried) 21 percent Mn from the Trout mill. The new mill at the Trout mine was completed and put into operation in 1938.

Nevada.—One carload of ore containing (natural) 38.75 percent Mn was shipped from Nevada in 1938.

New Mexico.—Shipments of manganese ore from New Mexico in 1938 came from the Luna Manganese Co. in Luna County and contained (natural) 45 percent Mn and 4 percent iron. Shipments of ferruginous manganese ore comprised 5,113 long tons containing (natural) 12.7 percent Mn and 41.2 percent iron from the Boston Hill mine near Silver City in Grant County and 980 tons containing (natural) 31.4 percent Mn and 8.8 percent iron from the Lake Valley mine in Sierra County.

Tennessee.—Operations in four counties—Carter, Johnson, Monroe, and Unicoi—supplied the total output of Tennessee in 1938, which comprised 3,603 long tons averaging (natural) 35.47 percent Mn shipped to metallurgical plants and 527 tons averaging (natural) 42.31 percent Mn shipped to chemical plants. The largest production came from the Embree Iron Co. in Unicoi County near Embreeville, where additional milling capacity was installed during the year. Most of the remainder was supplied by R. U. Butler from the Cedar Hill mine in Carter County. One small carload came from Monroe County near Sweetwater. Shipments of ferruginous manganese ore, which averaged (natural) 15.13 percent Mn, came principally from Johnson County.

Utah.—No manganese-bearing ores were shipped from Utah in 1938. The manganese deposits in the Drum Mountains, from which over 15,000 tons have been shipped in the past, have been described by Callaghan.[4]

Virginia.—Shipments of manganese ore from Virginia in 1938 decreased slightly compared with 1937 and comprised 928 tons of miscellaneous ore containing (natural) 41.92 percent Mn and 1,314 tons of metallurgical ore containing 40.94 percent Mn. The manganese ore originated in Appomattox, Bland, Campbell, Page, Shenandoah, and Smyth Counties. Shipments of ferruginous manganese ore in 1938 came from Allegheny, Augusta, Bland, Page, and Smyth Counties and averaged (natural) 24.85 percent Mn.

West Virginia.—The entire output of West Virginia in 1938 came from the Sweet Springs mine near Sweet Springs, Monroe County. This property, formerly operated by the Monroe Manganese Corporation, was worked in 1938 by the Appalachian Ores Co., which shipped 107 tons of miscellaneous ore averaging (dried) 40 percent Mn and 1 car to a metallurgical consumer containing (natural) 48 percent Mn and 2 percent iron.

Puerto Rico.—The entire output of Puerto Rico comes from the mine of the Atlantic Ore Co. about 3 miles from Juana Diaz and is shipped to the United States. Shipments in 1938 were 1,023 long tons containing 50 percent Mn.

IMPORTS OF MANGANESE ORE

Imports of manganese ore in 1938 decreased 47 percent from the record total of 1937. Receipts declined from all principal sources, except Cuba, the second largest source in 1938. The U. S. S. R. was the largest source and supplied 34 percent of the total. In addition to the 1938 imports shown in the following table, 30,051 tons of ore containing 8,689 tons of manganese (29 percent Mn) valued at $127,430 were imported from the Union of South Africa.

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[4] Callaghan, E., Manganese Deposits of the Drum Mountains: Econ. Geol., vol. 33, No. 5, August 1938, p. 508.

Manganese ore (35 percent or more Mn) imported for consumption in the United States, 1936–38, by countries

Country	Manganese ore (long tons)			Mn content (long tons)			Value		
	1936	1937	1938	1936	1937	1938	1936	1937	1938
Brazil	110, 018	77, 988	29, 698	52, 265	35, 505	13, 307	$872, 371	$597, 413	$220, 328
Canada	2, 435	196	2	1, 159	104	1	32, 380	4, 678	68
Chile	3, 828	398		1, 848	191		36, 259	4, 803	
Cuba	37, 876	122, 937	131, 423	17, 461	56, 385	61, 535	521, 370	2, 185, 800	2, 242, 425
France	59	95	68	29	48	35	11, 975	18, 703	12, 933
Germany	113	64		55	31		29, 870	17, 272	
Gold Coast	241, 593	254, 547	126, 858	125, 893	130, 147	63, 890	3, 166, 498	2, 942, 430	1, 500, 813
India, British	126, 913	70, 380	25, 480	65, 699	36, 523	13, 121	1, 307, 436	679, 232	236, 945
Netherland India	552	1, 126		279	631		14, 082	28, 607	
Philippine Islands			4, 002			1, 600			44, 075
Union of South Africa	99	209		50	119		1, 347	3, 125	
U. S. S. R	289, 867	383, 949	166, 043	141, 070	186, 736	80, 673	2, 716, 401	3, 959, 955	2, 661, 557
Other countries	9	30	14	4	14	7	1, 810	9, 584	253
	813, 362	911, 919	483, 588	405, 812	446, 434	234, 169	8, 711, 799	10, 451, 602	6, 919, 397

Cuba

STOCKS

Stocks of manganese ore in bonded warehouses rose for the second successive year and reached a peak of 842,048 long tons containing 418,721 tons of Mn at the end of 1938. This abnormally high level of stocks resulted from low activities in the domestic steel industry and from overbuying in 1937.

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 1 long ton (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 prices in the following table are quoted from the Engineering and Mining Journal.

Domestic prices of metallurgical manganese ore in 1938, 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	$0.46	$0.27	South African:		
Chilean, 47 percent Mn	.46	.28	50–52 percent Mn	$0.45	$0.28
Indian, 50 percent Mn	.45	.30	44–48 percent Mn	.40	.25
Caucasian, 52–55 percent Mn	.45	.30			

According to the Engineering and Mining Journal the prices for chemical (battery-grade) ores per long ton in carload lots during 1938 were as follows: Domestic chemical ores containing 70 to 72 percent manganese dioxide dropped about $5 in August and were quoted at $43 to $47 for the rest of the year, while imported ores containing 80 to 85 percent manganese dioxide were quoted at $45 to $60.

CONSUMPTION OF MANGANIFEROUS RAW MATERIALS

The following table shows the indicated consumption of manganiferous raw materials in the United States in 1938. 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 1938

	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	[1] 26,344	45	72,699	16	275,240	7.4
Imports for consumption	483,588	48	30,051	29	[2] 75,285	7.7
Total available for consumption	509,932	48	102,750	20	350,525	7.5

[1] Includes shipments from Puerto Rico. [2] Estimated.

Besides the material shown in the foregoing table, 358,200 long tons of ore containing 2 to 5 percent Mn were used presumably in the manufacture of manganiferous pig iron in 1938 compared with 879,800 tons in 1937. Figures are not available for imports of this class of ore.

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 in United States, 1937–38, in long tons

	1937		1938	
	Alloy	Manganese	Alloy	Manganese
Ferromanganese:				
Imported	29,559	23,888	26,258	21,118
Domestic production	376,443	299,425	242,994	191,104
From domestic ore [1]	5,484	4,276	13,926	10,996
From imported ore [1]	370,959	295,149	229,068	180,108
Total	406,002	323,313	269,252	212,222
Ratio (percent) of Mn in ferromanganese of domestic origin to total Mn in ferromanganese made and imported		1.32		5.18
Number of plants making ferromanganese	7		8	
Spiegeleisen:				
Imported	16,841	[1] 3,368	17,248	[1] 3,450
Domestic production	(2)	(2)	11,311	2,289
From domestic ore [1]	(2)	(2)	11,060	2,249
From imported ore [1]	(2)	(2)	251	40
Total	(2)	(2)	28,559	5,739
Ratio (percent) of Mn in spiegeleisen of domestic origin to total Mn in spiegeleisen made and imported		(2)		39.19
Number of plants making spiegeleisen	3		3	
Total available supply of metallic manganese as alloys		(2)		217,961
Percent of available supply of manganese in—				
Ferromanganese and spiegeleisen imported		(2)		11.27
Ferromanganese made from imported ore		(2)		82.63
Spiegeleisen made from imported ore		(2)		.02
Ferromanganese made from domestic ore		(2)		5.05
Spiegeleisen made from domestic ore		(2)		1.03
Ferromanganese and spiegeleisen made from domestic ore		(2)		6.08
Spiegeleisen made and imported		(2)		2.63
Total open-hearth and Bessemer steel	49,722,230		27,844,961	

[1] Estimated. [2] Bureau of Mines not at liberty to publish figures.

Ferromanganese.—The domestic output of ferromanganese in 1938, which dropped 35 percent from 1937, was produced at the following plants.

Bethlehem Steel Co., Johnstown, Pa.
Carnegie-Illinois Steel Corporation, North Braddock and Etna, Pa.
Colorado Fuel & Iron Corporation, Pueblo, Colo.
Electro Metallurgical Co., Alloy, W. Va.
Jones & Laughlin Steel Corporation, Aliquippa, Pa.
E. J. Lavino & Co., Reusens, Va.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to the above plants, shipments were made by 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, 1934–38

Year	Ferromanganese produced			Materials consumed (long tons)				Manganese ore used per ton of ferromanganese made (long tons)
	Long tons	Mn contained		Manganese ore		Iron and manganiferous iron ores	Cinder, scale, and purchased scrap	
		Percent	Long tons	Foreign	Domestic			
1934	139,171	78.67	109,491	256,980	853	13,933	3,304	1.853
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

The sources of the foreign ore used in the domestic production of ferromanganese are shown in the following table.

Foreign manganese ore used in manufacture of ferromanganese in the United States, 1934–38, in long tons

Source of ore	1934	1935	1936	1937	1938
Africa	46,096	69,857	199,143	150,112	152,698
Brazil	55,778	47,663	86,032	112,238	64,060
Chile	451	2,941	832	186	
Cuba	16,242	56,411	32,317	60,012	36,295
India	21,460	76,983	105,289	62,199	55,965
Philippine Islands		520			
U. S. S. R.	116,953	147,471	171,501	313,305	107,720
	256,980	401,846	595,114	698,052	416,738

Shipments of ferromanganese in 1938 decreased 38 percent from 1937. The record of shipments during the last 5 years has been as follows:

Ferromanganese shipped from furnaces in the United States, 1934–38

Year	Long tons	Value	Year	Long tons	Value
1934	147,947	$12,345,697	1937	359,842	$30,696,748
1935	194,627	16,374,328	1938	223,720	19,144,884
1936	322,353	24,088,298			

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 1938 included 257 long tons containing not over 1 percent carbon, 5,999 tons containing over 1 but less than 4 percent carbon, and 20,002 tons containing not less than 4 percent carbon.

Ferromanganese imported into and exported from the United States, 1934–38

Year	Imports for consumption			Exports [1]	
	Gross weight (long tons)	Mn content (long tons)	Value	Gross weight (long tons)	Value
1934	23,349	18,702	$1,441,360	222	$12,580
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

[1] Includes spiegeleisen; not separately classified.

Norway supplied 50 percent of the imports in 1938. Distribution of imports by countries is shown in the following table.

Ferromanganese imported for consumption in the United States, 1937–38, by countries

Country	1937		1938	
	Mn content (long tons)	Value	Mn content (long tons)	Value
Canada	3,385	$426,759		
Czechoslovakia	944	57,919	3,043	$211,356
France	760	101,901	1,137	152,068
Italy	43	5,706		
Japan	722	84,698	308	37,118
Netherlands	282	17,033	5,843	403,561
Norway	17,468	1,447,177	10,547	953,045
Poland and Danzig	156	9,897		
United Kingdom	128	12,526		
Yugoslavia			240	13,800
	23,888	2,163,616	21,118	1,770,948

Customs districts through which imported ferromanganese entered in 1937 and 1938 were as follows:

Manganese content of ferromanganese imported for consumption in the United States, 1937–38, by customs districts, in long tons

Customs district	1937	1938	Customs district	1937	1938
Buffalo	2,055	389	New Orleans	913	1,126
Chicago	363	1,585	New York	499	1,090
Connecticut		163	Oregon	315	334
Galveston	55		Philadelphia	1,297	3,526
Los Angeles	1,095	96	Pittsburgh	9	
Maryland	12,605	12,157	San Francisco	1,415	160
Massachusetts	78	39	Washington (State)	209	131
Michigan	2,350	322			
Mobile	630			23,888	21,118

Stocks of ferromanganese in bonded warehouses at the end of 1938 were 8,392 long tons containing 6,974 tons of Mn compared with 11,788 tons containing 9,690 tons of Mn at the end of 1937.

The quoted prices of ferromanganese dropped $10 per long ton for the last half of 1938, as shown in the following table.

Prices per long ton of ferromanganese in the United States, 1936–38 [1]

[80 percent—delivered at Pittsburgh]

Month	1936	1937	1938	Month	1936	1937	1938
January	$90.13	$84.79	$107.49	July	$80.13	$107.29	$97.77
February	80.13	84.79	107.49	August	80.13	107.29	97.77
March	80.13	92.29	107.49	September	80.13	107.29	97.77
April	80.13	99.79	107.49	October	80.13	107.29	97.77
May	80.13	107.29	107.77	November	80.13	107.39	97.77
June	80.13	107.29	107.77	December	82.65	107.49	97.77

[1] Steel, vol. 104, Jan. 2, 1939.

Spiegeleisen.—Shipments of spiegeleisen dropped sharply in 1938 and amounted to only 18 percent of the 1937 figure.

Spiegeleisen produced and shipped in the United States, 1934–38

Year	Produced (long tons)	Shipped from furnaces		Year	Produced (long tons)	Shipped from furnaces	
		Long tons	Value			Long tons	Value
1934	(1)	45,769	$1,099,922	1937	(1)	134,983	$3,969,822
1935	60,018	54,793	1,303,574	1938	11,311	24,939	80,830
1936	95,137	92,336	2,249,217				

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

Spiegeleisen was manufactured at the following plants in 1938:

E. J. Lavino & Co., Reusens, Va.
New Jersey Zinc Co., Palmerton, Pa.
Tennessee Coal, Iron & Railroad Co., Ensley, Ala.

In addition to these plants the Keokuk Electro-Metals Co., Keokuk, Iowa, made shipments from stock.

Most of the spiegeleisen produced in the United States in recent years has been made from domestic raw materials, but 317 long tons of foreign ore containing 48.58 percent Mn were consumed in 1938 in the manufacture of spiegeleisen.

Imports of spiegeleisen for consumption in 1938 increased slightly over 1937. Canada, with 16,783 tons, furnished 97 percent of the supply, while the remaining tonnage came from Norway and the Netherlands.

Spiegeleisen imported for consumption in the United States, 1934–38

Year	Long tons	Value	Year	Long tons	Value
1934	21,184	$595,017	1937	16,841	$589,766
1935	32,384	915,134	1938	17,248	625,480
1936	52,011	1,404,983			

The quoted prices of spiegeleisen at producers' furnaces dropped $5 per long ton July 1 and remained at $28 for 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 275,240 long tons of domestic ore containing 5 to 10 percent Mn and 358,200 tons containing 2 to 5 percent Mn were shipped in 1938. Foreign manganiferous iron ore (75,285 tons) also was consumed in the manufacture of pig iron. The sources of the foreign ores for the last 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, 1936–38, in long tons

Source of ore	Ferruginous manganese ore			Manganiferous iron ore		
	1936	1937	1938	1936	1937	1938
Africa:						
Egypt	26,244	57,176				
Undistributed			11,753	3,737	446	
Asia:						
Palestine		323				
Philippine Islands		2,257	2,887			
Undistributed		2,541				
Australia	9,127			94,818	140,372	61,473
Brazil			2,829			9,597
Cuba	103					
Spain					1,658	
Sweden				4,524		4,215
Undistributed		6,982	6,005			
	35,474	69,279	23,474	103,079	142,476	75,285

BATTERY INDUSTRY

Shipments of manganese ore to battery makers by domestic producers in 1938 totaled 4,959 long tons and shipments from Puerto Rico 1,023 tons, indicating a consumption of 5,982 tons of domestic materials in battery manufacture. Imported manganese ore also was consumed in the battery industry, but no figures are available for such imports.

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.

WORLD PRODUCTION

The following table shows, insofar as statistics are available, the world production of manganese ores from 1934 to 1938 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 the principal countries, 1934–38, in metric tons

[Compiled by R. B. Miller]

Country [1]	Percent Mn	1934	1935	1936	1937	1938
North America:						
Canada (shipments)	----------	----------	91	200	77	----------
Costa Rica	----------	----------	----------	----------	100	303
Cuba	36–50+	68,064	35,269	48,471	131,299	123,844
Mexico	40+	664	3,217	3,377	17	117
United States:						
Continental (shipments, exclusive of fluxing ore)	35+	26,940	26,852	32,635	40,887	25,727
Puerto Rico [3]	48–51	1,738	3,412	3,058	2,381	1,039
South America:						
Argentina [4]	35–38	583	439	443	(5)	(2)
Brazil	38–50	7,527	41,767	156,201	253,661	221,961
Chile [3]	40–50	4,065	4,370	5,180	13,015	(2)
Europe:						
Bulgaria	30–45	----------	----------	1,500	3,000	(2)
Germany	30+	515	224	242	226	(2)
Greece	30+	1,206	423	1,680	6,952	(2)
Hungary	35–48	10	6,291	27,228	25,088	22,221
Italy	34–37	6,941	9,127	24,132	33,532	(2)
Portugal	40+	295	158	290	317	999
Rumania	30–36	12,057	19,795	33,856	50,749	(2)
Spain	31–34	3,796	1,260	(5)	(5)	(2)
Sweden	30–50	5,832	6,495	5,943	5,845	(2)
U. S. S. R.	41–48	1,821,000	2,384,600	3,002,000	2,700,000	(2)
Yugoslavia	32–38	1,103	928	2,739	4,420	3,758
Asia:						
China [3]	45–46	870	827	23,794	51,446	1,247
India:						
British	47–52	412,827	651,779	826,498	1,068,472	901,649
Portuguese	42–50+	3,800	4,064	2,662	4,077	(2)
Indochina	----------	----------	1,568	3,430	5,287	(2)
Japan	49–51	57,165	71,659	67,753	(5)	(2)
Netherland India	50–55	11,635	12,353	8,619	11,083	(2)
Philippine Islands [3]	45–50	----------	519	255	12,206	49,359
Turkey	30–50	13	15,600	5,200	530	(2)
Unfederated Malay States	30	18,948	28,504	37,366	33,319	32,483
Africa:						
Belgian Congo	56	----------	----------	----------	27,471	(2)
Egypt	30+	959	87,303	134,972	186,320	(2)
Gold Coast [3]	50+	371,039	437,571	417,621	535,495	(2)
Morocco:						
French	40–50+	7,300	24,685	39,360	76,470	84,322
Spanish	38	----------	----------	----------	660	(2)
Northern Rhodesia	30–48	2,074	4,040	3,071	2,379	2,779
Union of South Africa	30–51	65,497	95,450	258,244	631,194	563,762
Oceania:						
Australia:						
New South Wales	----------	105	150	73	109	(2)
Queensland	----------	----------	----------	----------	1,052	(2)
South Australia	----------	2	----------	----------	----------	(2)
	----------	2,915,000	3,981,000	5,179,000	5,987,000	(2)

[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 then 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] Exports.
[4] Shipments by rail and river.
[5] Estimate included in total.

Brazil.—Production in Brazil was at a lower rate in 1938; exports were 143,670 metric tons in 1938 compared with 225,682 tons in 1937. The drop was due almost entirely to smaller shipments to the United States. On June 7, 1938, the National Iron Ore and Manganese Producers' and Exporters' Association (Sindicato Nacional de Productores e Exportadores de Minerios de Ferro e Manganês) was founded, whose general object is to coordinate, direct, and supervise exploitation of and trade in these commodities. The association plans to maintain an adequate statistical service and a laboratory for the analysis of ores. Membership in the association comprises most of the larger producers.

Cuba.—Output by the Cuban-American Manganese Corporation, the principal producer in Cuba, totaled 123,844 metric tons (dried) in 1938, of which 87,419 tons were nodulized concentrates and 36,425 tons were washed, jigged, or sorted ore. Exports were 118,978 tons, of which 88,731 tons were nodulized concentrates and 30,247 tons were washed, jigged, or sorted ore. The latter material contains 39 to 40 percent Mn, while typical cargo analyses of shipments of nodules are as follows:

Analyses of shipments of nodulized concentrates, percent

Mn	51.00	50.88	51.23	50.77	50.09
Fe	2.61	------	2.78	2.65	3.15
SiO_2	10.92	10.89	10.86	9.87	10.26
Al_2O_3	3.00	------	3.44	3.60	3.85
CaO	------	------	------	7.24	5.62
P	.088	.094	.083	.091	.092
Moisture	.08	1.06	.62	.10	1.54

It was reported that mining operations were begun in the El Sabalo area in Pinar del Rio in 1938.

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.

India, British.—Water-borne exports from India, normally the second largest producer in the world, decreased to 582,492 metric tons in 1938 from 996,934 in 1937. These figures do not include exports through Mormugao, which were 173,383 tons in 1937.

Union of South Africa.—Output in the Union of South Africa in 1938 fell slightly below the peak figure established in 1937. Virtually all the production came from deposits north of Postmasburg in Griqualand West, Cape Province. All Cape ore is exported; exports in 1938 were 319,051 metric tons. Several grades of ore are shipped containing from 28 to over 50 percent Mn, and a large part of the shipments consist of ore containing less than 45 percent Mn. Small quantities (965 metric tons in 1938) of wad, together with some high-grade pyrolusite and psilomelane, were produced in the Krugersdorp district, Transvaal, for local consumption only.

U. S. S. R.—Data showing production in the U. S. S. R. in 1938 are not available. Two mining districts, Chiaturi and Nikopol, supply the bulk of the Russian output. Virtually all the Chiaturi ore is exported, while Nikopol supplies the bulk of the domestic consumption. Other deposits in the Urals and Western Siberia supply the remaining domestic requirements. Exports for the first 9 months of 1938 were 269,930 metric tons.

CHROMITE

By Robert H. Ridgway

SUMMARY OUTLINE

World production of chromite in 1938 receded from the all-time peak established in 1937. Relatively small increases in output in Turkey and the Union of South Africa were more than offset by the drastic decreases in Southern Rhodesia and Cuba. Although complete data are not yet available it is doubtful whether the 1938 total will reach 1,000,000 long tons. Exports from all producing countries except Turkey were lower in 1938 than in 1937, reflecting the lower demand (principally in the United States).

Lower prices accompanied the sharp drop in demand, but, unlike 1937, ample supplies were available throughout the year. Imports into the United States decreased 36 percent, and delivery was suspended on some contracts to American consumers because of slack demand and stocks on hand. Exploration and development work continued in the Western States. One domestic consumer of chromite has been very active in the field during the past 2 years. The United States Chrome Mines, Inc., plans to expand production materially in 1939. Output is to come from Eldorado and San Luis Obispo Counties, Calif.

The following table compares the salient statistics of the chromite industry in the United States 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 1934–38

	1925–29 (average)	1934	1935	1936	1937	1938
Apparent available supply:						
Imports ... long tons	224,357	192,297	259,063	324,258	553,916	352,085
Shipments from domestic mines ... long tons	276	369	515	269	2,321	812
	224,633	192,666	259,578	324,527	556,237	352,897
Price per long ton at New York, approximate average of all grades	$22.46	$19.00	$17.70	$17.76	$22.55	$21.59
Imports:						
Africa [1] ... percent of total	63	26	36	37	50	48
Cuba ... do	15	26	18	22	17	11
Greece ... do	9	12	8	8	5	3
New Caledonia ... do	6	10	22	20	9	8
Turkey ... do	---	15	6	6	7	6
U. S. S. R. ... do	---	10	1	1	---	---
Other countries ... do	7	1	9	6	12	[2] 24
World production ... long tons	428,000	589,000	780,000	1,051,000	(3)	(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 14 years.

Emergency stock pile.—Chromite is listed by the War Department as one of the four mineral commodities constituting the first priority class for stock-pile reserves. Its importance is appreciated more readily when it is realized that the steel industry accounts for three-fourths of the domestic consumption. The strategic nature of

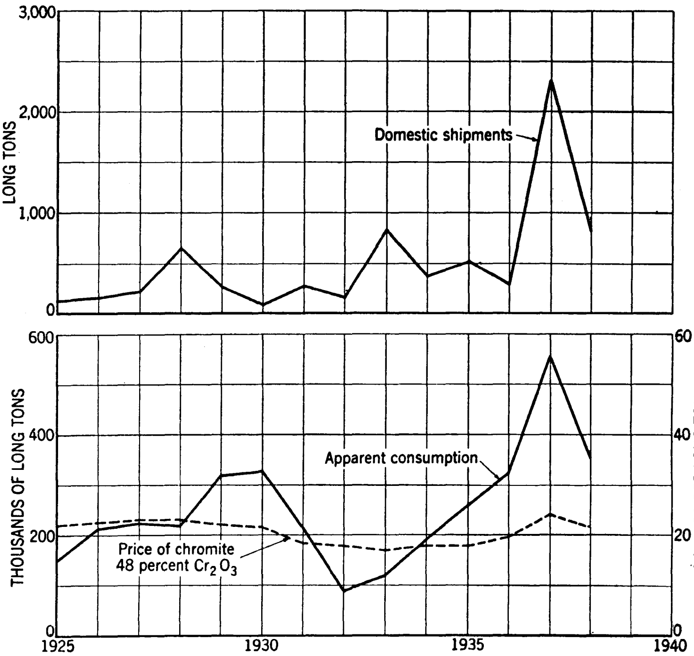

FIGURE 1.—Trends in consumption, price, and domestic shipments of chromite in the United States, 1925–38.

chromite is demonstrated in the following table, which shows domestic production, imports, and apparent supply from 1910 through 1938.

Several bills have been introduced into Congress looking to the purchase of stock piles of strategic materials, and hearings on the subject have been held by both the House and Senate military affairs committees. The Senate recently (April 3, 1939) passed a bill (S. 572) which provides $10,000,000 a year for the fiscal years 1940 to 1943 (the fiscal year ends June 30) for the purchase of strategic and critical materials. A similar bill (H. R. 5191) has been reported to the House by the House Military Affairs Committee. This bill, however, provides a total of $100,000,000 for four years.

During the past 2 years the Navy Department has received a small appropriation to provide stock piles of strategic commodities, and specifications and schedules for the purchase of 2,000 short tons of metallurgical chromite were released late in 1937. The bids were called for January 4, 1938, and a domestic producer was the lowest bidder. Accordingly he was awarded the contract, which called for delivery within 120 days. After two time extensions the producer had not delivered and asked for a further extension which was not granted, so the contract was canceled. Bids were then called for February 23, 1939, and the award was made on March 14, 1939, to E. J. Lavino & Co., which will supply ore from Southern Rhodesia.

Domestic production, imports, and apparent available supply of chromite in the United States, 1910–38, in long tons

Year	Domestic production (shipments from mines)				Imports	Apparent available supply [1]
	California	Oregon	Other States [2]	Total		
1910	205			205	38,579	38,784
1911	120			120	37,540	37,660
1912	201			201	53,929	54,130
1913	255			255	65,180	65,435
1914	506		85	591	74,686	75,277
1915	3,281			3,281	76,455	79,736
1916	43,758	3,099	178	47,035	115,945	162,980
1917	36,774	6,701	250	43,725	72,063	115,788
1918	63,147	18,454	829	82,430	100,142	182,572
1919	3,272	538	1,269	5,079	61,404	66,483
1920	1,416	955	131	2,502	150,275	152,777
1921	123	159		282	81,836	82,118
1922	163	79	113	355	90,081	90,436
1923	69	78	80	227	129,693	129,920
1924	188	100		288	118,343	118,631
1925	83		25	108	149,739	149,847
1926	91		50	141	215,464	215,605
1927	[3] 201			201	222,360	222,561
1928	652		8	660	216,592	217,252
1929	269			269	317,630	317,899
1930	80			80	326,617	326,697
1931	268			268	212,528	212,796
1932	155			155	89,143	89,298
1933	843			843	116,511	117,354
1934	369			369	192,297	192,666
1935	515			515	259,063	259,578
1936	269			269	324,258	324,527
1937	2,033	288		2,321	553,916	556,237
1938	812			812	352,085	352,897

[1] Domestic production plus imports; no exports recorded, 1910–38.
[2] Maryland, North Carolina, Washington, and Wyoming.
[3] According to the Division of Mines and Mining, Department of Natural Resources, California.

DOMESTIC PRODUCTION

Domestic production, as measured by shipments from the mines, decreased from 2,321 long tons in 1937 to only 812 tons in 1938. The entire output came from California and was produced in Eldorado, Placer, and Napa Counties. With the exception of 2 carloads the 1938 output came from the United States Chrome Mines, Inc., in Eldorado County where a mill with a capacity of 200 tons a day has been installed. It was reported that shipments from this property in 1938 averaged 49 percent Cr_2O_3. Aside from production and development work in California, exploration was continued in other Western States. Certain features of characteristic deposits in California and Oregon have been described by Allen.[1] With regard to deposits in Oregon, Allen[2] has the following to say:

Chromite in Oregon occurs in the southwestern and northeastern parts of the State, in rocks of the peridotite or serpentine types. The deposits vary in form from thin stringers through narrow lenses to thicker and shorter kidneys and in size from a few inches up to masses whose outcrops are 40 feet in width and 150 feet or more in length. Only 11 of the deposits visited in Oregon had

[1] Allen, John Eliot, Geological Features of West Coast Chromite Deposits: Min. and Met., vol. 20, No. 386, February 1939, p. 100.
[2] Allen, John Eliot, Chromite Deposits in Oregon: Oregon Dept. of Geol. and Min. Ind. Bull. 9, 1938, p. 11.

individual kidneys of ore with visible outcrops larger than 5 feet wide and 10 feet long. When ore bodies occur in groups, which is common, individual masses often follow a recognizable scheme of orientation; they may be in line, staggered or overlapping, parallel, or irregularly placed with respect to each other. Nearly all the ore bodies are considerably broken and faulted, and they usually lie in a sheared and altered zone in the country rock.

The same publication also contains chapters entitled "The Present Commercial Aspect of Western Chrome Ores," by H. F. Byram, and "Preliminary Geophysical Investigation on the Sourdough Chromite Deposit in Oregon," by F. W. Lee.

Chromite is known to occur in the basic rocks of western North Carolina and northern Georgia, but there has been little or no production from this area since the World War. The Tennessee Valley Authority has investigated the deposits in this area, and Hunter [3] reports as follows:

It is not practical under the present economic conditions to mine chromite from the small deposits in North Carolina and Georgia, but in case of necessity a limited amount of chromite can be quickly recovered from the several small deposits.

In connection with its program of devising low-cost methods of utilizing low-grade domestic sources of minerals, particularly strategic minerals, the Bureau of Mines has developed methods of concentrating western chromite ores and producing pure chromium chloride cheaply.[4]

Chromite (ores and concentrates) shipped from mines in the United States, 1934–38

[All from California except in 1937 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
1934	320	(1)	49	(1)	369	$4,653
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

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.

IMPORTS [5]

Imports of chromite in 1938 decreased 36 percent from the record total of 1937. This large decline was shared by all the principal sources except the Philippine Islands, from which imports increased 79 percent. The increase from the Philippines resulted from hold-over contracts and shipping on consignment, and much of the ore was in storage at the close of the year. The chromite imported in 1938 contained 46.5 percent chromic oxide. Of the principal imports

3 Eckel, E. C., Hunter, C. E., and Mattocks, P. W., Iron, Chromite, and Nickel Resources of the Tennessee Valley Region: T. V. A. Geol. Bull. 10, April 1938, p. 20.
4 Dean, R. S., and others, Progress Reports—Metallurgical Division. 25. Annual Report of the Metallurgical Division, Fiscal Year 1937-38: Bureau of Mines Rept. of Investigations 3419, 1938, pp. 7-8, 41.
5 Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

in 1938, those from New Caledonia had the highest content of chromic oxide (54 percent) and those from Cuba the lowest (32 percent).

Crude chromite imported into the United States, 1934–38, by countries

Country	1934 (long tons)	1935 (long tons)	1936 (long tons)	1937 (long tons)	1938		
					Long tons		Value
					Gross weight	Chromic oxide content	
Africa [1]	48,848	92,682	120,011	277,420	168,299	80,140	$2,621,404
Cuba	49,370	47,743	69,963	93,098	39,529	12,773	198,173
Greece	23,301	20,692	26,688	24,583	12,000	5,125	190,755
India, British	400	14,926	14,795	23,939	4,051	1,883	53,132
New Caledonia	19,530	55,686	65,450	51,831	28,520	15,270	388,534
Philippine Islands		787	4,986	43,648	78,233	38,221	915,221
Turkey	28,730	16,060	19,490	39,391	20,392	9,650	469,145
U. S. S. R.	19,937	3,412	2,310				
Other countries	2,181	7,075	565	6	1,061	508	18,528
	192,297	259,063	324,258	553,916	352,085	163,570	4,854,892

[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 1934 to 1938.

Chromium compounds imported for consumption in the United States, 1934–38

Year	Chromic acid		Chromate and bichromate of potash		Chromate and bichromate of soda	
	Pounds	Value	Pounds	Value	Pounds	Value
1934	2,149	$1,011	22	$5	110	$32
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		

Ferrochrome or ferrochromium and chrome or chromium metal imported for consumption in the United States, 1934–38, in long tons

Class	1934	1935	1936	1937	1938
Ferrochrome or ferrochromium—					
Containing 3 percent or more carbon (chromium content)		30	4	96	(1)
Containing less than 3 percent carbon (gross weight)	110		104	248	175
Chrome or chromium metal	16	49	57	78	39

[1] 60 pounds.

CONSUMPTION

Owing to lack of data concerning consumers' stocks it is impossible to estimate accurately the total consumption of chromite in the United States. However, the apparent available supply decreased from the record total of 1937 but was larger than for any other year. Data since 1910 are given in a preceding table.

The steel industry consumes more than three-fourths of the supply of chromite either as a refractory or as the raw-material source of an important alloying element. With the slump in the steel industry, a decline in the demand for chromite ensued. The domestic automobile industry, one of the important users of alloy steels and chromium plating, decreased its output from 4,809,565 cars in 1937 to 2,489,635 in 1938, the lowest since 1933. 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 1937 but was only about three-fourths of the average annual volume from 1920 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 to 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. Although chromium is used in a number of alloy steels, its largest and best-known use is in the manufacture of stainless steels. A new process has been developed for introducing chromium into steel, permitting production of chromium steels in the open-hearth furnace as well as the electric furnace.[6]

In recent years chromium plating has had a wide field of uses and has become important industrially, but the amount of raw material consumed is small owing to the thinness of the layer of metal deposited.

Refractory.—Chromite with certain physical and chemical properties is used for refractories. Aside from its use in bricks, lump and ground chromite and chromite cements are used extensively in building and patching furnaces.

According to the Bureau of the Census the production of chrome and magnesite brick was 22,758,000 brick valued at $6,726,943 in1937 compared with 12,112,000 brick valued at $3,424,726 in 1935; stocks were 9,340,000 brick at the end of 1937 compared with 3,228,000 brick at the end of 1935.

Domestic trade-journal quotations for chromite brick dropped from $49 to $47 per short ton in May 1938.

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.

According to the Bureau of the Census the production of sodium bichromate and chromate was 48,697 short tons valued at $5,925,611 in 1937 compared with 42,325 tons valued at $4,762,728 in 1935. The production of chromic acid was 8,997,337 pounds valued at $1,260,477 in 1937 compared with 6,723, 304 pounds valued at $887,842 in 1935.

PRICES

Prices of chromite quoted in the domestic trade journals are for imported ore and are given in dollars per long ton c. i. f. North Atlantic ports. The quotations are largely nominal. According to Steel, chromite containing 48 percent chromic oxide was quoted at $25.50 to

[6] Steel, Progress in Steelmaking: Vol. 104, No. 1, Jan. 2, 1939, pp. 314-315.

$26.50 at the beginning of 1938. Price decreases carried the quotation down to $23 to $24 during the last quarter of the year. Ore with a lower chromic oxide content usually brings a lower price.

WORLD PRODUCTION

Complete data are not yet available on world output of chromite in 1938. The large drop in the output of Southern Rhodesia, the principal producer in 1937, probably will result in a lower world figure in 1938 than in 1937 despite increases in some other countries. Excluding the U. S. S. R., for which no data are available for 1937 and 1938, Turkey was the largest producer in 1938, followed by Southern Rhodesia and the Union of South Africa.

World production of crude chromite, 1934–38, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Australia (New South Wales)	1,744	605	422	466	(1)
Brazil [2]		5	3,890	2,980	(1)
Bulgaria	85	325	270	2,350	(1)
Canada (shipments)	101	1,037	837	3,876	
Cuba [3]	50,162	48,509	71,086	94,592	40,163
Cyprus (shipments)	982	1,198	508	1,641	(1)
Greece	30,694	29,779	47,347	52,620	(1)
Guatemala [3]	805				
India, British	21,922	39,755	50,280	63,307	(1)
Japan	27,222	36,309	39,039	(1)	(1)
Levant		800			(1)
New Caledonia	55,182	55,311	47,832	48,022	(1)
Norway	42			176	(1)
Philippine Islands [2]		1,292	11,891	69,856	66,911
Southern Rhodesia	72,099	105,913	183,395	275,617	186,019
Turkey (Asia Minor)	119,844	150,472	163,880	192,508	[4] 205,000
Union of South Africa	61,357	90,430	175,669	168,620	183,570
U. S. S. R.	127,400	177,900	217,000	(1)	(1)
United Kingdom				305	(1)
United States (shipments)	375	523	273	2,358	825
Yugoslavia	28,314	[5] 52,367	[5] 54,044	[5] 59,932	[5] 51,000
	598,000	793,000	1,068,000	(1)	(1)

[1] Data not yet available.
[2] Exports.
[3] Imports into the United States.
[4] Estimated.
[5] Crude ore.

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. The bulk of the chromite produced thus enters international trade. World exports were lower in 1938 than in 1937 when a record figure was established. 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 Norway.

A brief summary of the activities in the principal chromite producing and consuming countries follows.

Canada.—A small quantity of chromite is produced annually in the Thetford-Black Lake area of the Eastern Townships of Quebec, but no shipments were reported for 1938. The Asbestos Corporation of

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Canada has been mining chromite at one of its properties in the Thetford asbestos field, southern Quebec. Development work on the property at Obonga Lake near Collins, Ontario, by the Chromium Mining & Smelting Corporation did not reveal a deposit of economic importance. The company, however, is proceeding with its metallurgical developments using ore from foreign sources. The process, it is claimed, permits production of low-carbon ferrochromium from low-grade chromite.

Cuba.—The entire Cuban output moves to the United States; imports into the United States from Cuba in 1938 were 40,163 metric tons compared with 94,592 tons in 1937. Cuban ores have a low content of Cr_2O_3 and are used in the refractory industry.

Cyprus.—The milling plant of the Cyprus Chrome Co., Ltd., at Ayios Nikolaos was completed about the middle of 1937. Owing to technical difficulties and the necessity of installing additional machinery, the plant was not in full operation at the beginning of 1938, but a trial shipment of about 500 tons of concentrates in 1937 averaged 51.2 percent Cr_2O_3. Concentration is done on magnetic separators, wet classifiers, and tables, and the plant is reported to have a capacity of 50 tons of concentrates per day. Known reserves at the Kokkinorotsos mine were increased as a result of development work.

France.—France depends on foreign sources for its domestic requirements. Imports in 1938 totaled 40,178 metric tons of which 3,305 came from French colonies compared with 38,171 tons with no shipment from the colonies in 1937. New Caledonia is the only French colony where any appreciable amount of chromite is found, but recently occurrences of chromite have been reported in Dahomey.[7]

Germany.—Germany does not produce chromite. Imports were 176,406 metric tons in 1938 compared with 132,162 tons in 1937. Of the 1938 total, 34 percent came from the Union of South Africa and 30 percent from Turkey. Chromite trade between the Union of South Africa and Germany may be expanded as a result of a trade agreement between the two countries concluded late in 1938.

Greece.—Exports of chromite from Greece were 35,661 metric tons in 1938 compared with 55,945 tons in 1937. Of the 1938 total, 18,160 tons went to Germany compared with 11,245 tons in 1937. 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.—Production data for India in 1938 are not yet available, but exports showed a large decline. Water-borne exports dropped sharply to 18,506 metric tons in 1938 from 37,680 tons in 1937; however, these figures do not include exports through Mormugao, which amounted to 13,495 tons in 1937. The largest output comes from Baluchistan and Mysore State. The chief mines in Baluchistan are near Hindubagh in the Zhob Valley.

New Caledonia.—Preliminary figures show that exports of chromite from New Caledonia in 1938 were 39,780 metric tons compared with 69,753 tons in 1937. A large part of the New Caledonian ore comes from two mines, the Tiebaghi mine operated by British interests and the Fantouche mine operated by American interests. New Caledonian ores are of high grade.

[7] Chermette, A., Le Gisement de chromite de Bontomo, Haut-Dahomey: Service des Mines, French West Africa, Bull. 1, 1938, pp. 69-73.

A new mining company, known as the Société d'Exploitation de la mine Chagrin, with a capital of 500,000 francs has been organized in New Caledonia for the purpose, among other things, of acquiring and operating the Chagrin chromite mine.

Norway.—Imports of chromite into Norway in 1938 increased to 50,023 metric tons from 32,718 tons in 1937. Much of the chromite sent to Norway is smelted into ferrochromium, because of the available electric energy, and exported. Exports of ferrochromium, however, decreased to 11,603 tons in 1938 from 14,883 tons in 1937.

Philippine Islands.—The declining chromite market affected adversely the new chromite mining industry in the Philippines. Most of the ore comes from three mines, the Florannie, the Acoje, and the Consolidated. The first two mines yield ore that is shipped to metallurgical consumers, while the third mine yields a product low in Cr_2O_3 but high in Al_2O_3, which is shipped to manufacturers of refractory materials. The Florannie and Consolidated mines are operated by the Benguet Consolidated Mining Co., and Acoje is a Marsman property. Despite unfavorable market conditions, work at Florannie continued throughout the year in an effort to exhaust the ore body and withdraw. At the end of the year, according to the company report, only 1,500 tons remained in the mine. Production in 1938 was 20,982 tons. Operations at Consolidated, which amassed a stock of 25,000 tons, were suspended in May due to lack of orders. Exports from the Philippines in 1938 were 66,911 metric tons compared with 69,856 tons in 1937.

Southern Rhodesia.—Output in 1938 decreased 33 percent from the record figure in 1937 and amounted to 186,019 metric tons. Exports were 117,300 tons for the first 6 months of 1938.

Present output comes from two districts (the Selukwe district and along the great dike). Foremost among the Rhodesian chromite deposits are those in the Selukwe district where, at present, three mines are producing.[8] These are the Railway Block, the Selukwe Peak, and the Iron Peak. They are situated 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 ore is shipped direct after hand sorting and blending. Only a small proportion is treated; concentration is accomplished by classifiers, jigs, and tables.

Much of the Rhodesian output is controlled by a British syndicate. Early in 1938 the independent producers formed an association to facilitate marketing of their outputs.

Sweden.—Imports of chromite into Sweden decreased from 71,821 metric tons in 1937 to 49,627 tons in 1938. Exports of ferrochromium from Sweden were 13,124 tons in 1937.

Turkey.—Despite the apparent curtailment in world output of chromite in 1938, the production of Turkey continued to climb. Output may have exceeded 200,000 metric tons for the first time. Virtually all the ore is exported as there is little or no domestic demand; exports in 1938 were 208,055 metric tons, an increase of 5 percent over the 198,459 tons exported in 1937.

The principal producers of chromite in Turkey are the Société Anonyme Turque des Chromes de l'Est a Guleman (State), Société Miniere de Fethiye (French), Société Turque de Minerais (Swiss-

[8] Musgrave, J., Chrome Mining at Selukwe, Southern Rhodesia: Trans. Inst. Min. and Met., Nov. 17, 1938, pp. 1–16.

German), and Société Anonyme Turque de Chrome (Turkish). In addition there are several small companies. Production continued at the newly developed deposits at Guleman some 20 miles from the railroad at Ergani. An aerial tramway connects the mines with the Ergani-Diyarbekir Railway, and the ore is transported by rail to the port of Mersin. The district is rapidly becoming one of the most important chromite-mining centers in the world. Although most of the chromite is destined for export, plans call for the installation of a plant at Kutahya for the manufacture of ferrochromium. The following are typical analyses of commercial chromite exported from the Guleman district:

	Percent	
Cr_2O_3	49.00	52.00
SiO_2	2.00	2.25
FeO	10.00	10.75
MgO	16.00	18.00
Al_2O_3	16.00	17.00

Union of South Africa.—Output in the Union of South Africa likewise increased in 1938 when a record production of 183,570 metric tons was recorded—9 percent more than the 1937 total. Exports, however, declined appreciably and were 117,562 tons in 1938 compared with 169,537 tons in 1937. Reductions in railway freights to the ports have aided the competitive position of South African chromite.

U. S. S. R.—The U. S. S. R. is one of the largest producers of chromite. Output in recent years has been increasing and in 1936 was 217,000 metric tons; figures for 1937 and 1938 are not yet available. Exports are small as the output is consumed in domestic industries.

United Kingdom.—Imports of chromite into the United Kingdom in 1937 were 45,573 metric tons. 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 in Yugoslavia in 1938 was 51,000 metric tons, and exports were 23,310 tons. The Allatini Mines, Ltd., the principal producer, operates the mines at Orasje, 26 kilometers northwest of Skoplje.

NICKEL AND COBALT

By H. W. Davis [1]

SUMMARY OUTLINE

NICKEL

The demand for nickel in the United States in 1938 was adversely affected by the substantial recession of activity in the iron and steel industry, which uses the major portion of nickel. There was also a marked decline in the demand for nickel in most other outlets. Precise data on domestic nickel consumption are not available, but the 1938 total may be estimated roughly to have been 22,000 short tons, a decrease of about 50 percent from 1937. As usual, domestic production of primary metal was insignificant (416 short tons), and the output of secondary nickel totaled only 2,300 short tons. The domestic supply was derived chiefly from imports, largely from Canada. Domestic quotations for electrolytic nickel remained unchanged at 35 cents a pound throughout 1938.

In contrast to the marked reduction in the United States, consumption in Europe and elsewhere showed little change in 1938; consequently, world consumption (estimated at 102,000 short tons in 1938) was only about 16 percent less than in 1937.

Canada furnished about 88 percent of the world's nickel. The International Nickel Co. of Canada, Ltd., alone supplied more than 80 percent of the total nickel used in 1938.

Salient statistics for nickel, 1936–38

	1936	1937	1938
United States:			
Production (all byproduct of copper refining) short tons	107	219	416
Secondary production do	1,965	2,400	2,300
Imports [1] do	53,141	54,438	29,546
Exports [2] do	4,078	4,473	6,564
Price per pound [3] cents	35	35	35
Canada:			
Production short tons	84,870	[4] 112,453	105,337
Imports do	467	491	491
Exports do	86,819	111,385	98,852
World production (approximate) do	98,400	127,000	120,000

[1] Excludes "All other manufactures of nickel"; weight not recorded.
[2] Excludes "Manufactures"; weight not recorded.
[3] Price quoted by International Nickel Co. of Canada, Ltd., for electrolytic nickel at New York, in 2-ton minimum lots.
[4] 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.

Search for commercial deposits of nickel in the United States was under way in 1938, and prospecting and development were reported at several localities. Allsman[2] describes the mining of 55 tons of nickel-bearing rock from a prospect in southern Nevada by hand methods. The geology, mineralogy, and problems related to future development also are discussed briefly. Preliminary work on copper-nickel ores from the Bunkerville (Nev.) district was begun at the Boulder City laboratory of the Bureau of Mines. The nickel deposits at Webster and Democrat, N. C., are discussed in a recent report by the Tennessee Valley Authority.[3]

Because of the interest that has been centered lately on strategic and critical minerals from a military standpoint, as well as the fact that nickel has been classed by the Army and Navy Munitions Board as a strategic mineral, it seems fitting at this time to present a historic table comprising data on production and consumption since 1911.

Production, imports, exports, and apparent consumption of nickel in the United States, 1911–38, nickel content in short tons

Year	Primary				Secondary production
	Domestic production (byproduct of copper refining)	Imports	Exports	Apparent consumption	
1911	445	14,915	12,550	2,810	(1)
1912	328	23,159	12,908	10,579	(1)
1913	241	23,723	14,587	9,377	(1)
1914	423	17,549	13,798	4,174	(1)
1915	822	28,300	13,209	15,913	(1)
1916	918	36,325	16,702	20,541	[2] 816
1917	402	37,763	10,996	27,169	[2] 860
1918	441	36,613	8,735	28,319	1,393
1919	[3] 511	18,330	1,905	16,936	2,447
1920	[3] 365	24,246	608	24,003	2,200
1921	111	2,198	213	2,096	945
1922	208	7,472	[4] 3,200	4,500	1,512
1923	100	20,398	[4] 600	19,900	1,550
1924	191	18,542	[4] 900	17,800	2,240
1925	272	21,601	[4] 1,200	20,700	2,300
1926	323	[4] 19,300	[4] 700	18,900	3,050
1927	860	[4] 17,900	[4] 900	17,900	3,380
1928	522	[4] 30,300	[4] 900	29,900	4,500
1929	340	[4] 41,500	[4] 1,100	40,700	4,350
1930	308	[4] 25,300	[4] 1,200	24,400	2,900
1931	373	[4] 15,100	[4] 700	14,800	2,070
1932	195	[4] 9,400	[4] 800	8,800	1,450
1933	126	[4] 21,900	[4] 1,000	21,000	1,650
1934	157	[4] 21,000	[4] 1,700	19,500	1,850
1935	160	[4] 34,200	[4] 1,300	33,100	1,950
1936	107	[4] 47,600	[4] 2,500	45,200	1,965
1937	219	[4] 48,500	[4] 2,800	45,900	2,400
1938	416	[4] 26,200	[4] 4,200	22,400	2,300

[1] No canvass.
[2] Exclusive of recoveries by International Nickel Co. from scrap nickel or alloys.
[3] Includes nickel produced from complex sulfides mined in Missouri.
[4] Nickel content estimated.

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 shown in the following table. Further details on the production of secondary nickel are given in the chapter on Secondary Metals.

[2] Allsman, P. T., Cost of Mining 55 Tons of Copper-Nickel Ore at the Great Eastern Prospect, Bunkerville, Clark County, Nev.: Bureau of Mines Inf. Circ. 7029, 1938, 8 pp.
[3] Hunter, C. E., and Mattocks, P. W., Nickel Deposits at Webster and Democrat, N. C.: Tennessee Valley Authority, Geol. Bull. 10, April 1938, pp. 22-26.

Nickel produced in the United States, 1934–38

Year	Primary[1] Short tons	Primary[1] Value	Secondary[2] Short tons	Secondary[2] Value
1934	157	$108,414	1,850	$1,295,000
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

[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.

IMPORTS AND EXPORTS

The principal nickel imports of the United States are metallic nickel and nickel alloys, ore and matte (chiefly matte containing approximately 55 percent nickel and 25 percent copper), and nickel oxide. All the oxide, virtually all the ore and matte, and 98 percent of the metallic nickel and alloys were obtained from Canada in 1938; Europe supplied the remainder of the ore, matte, and 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.

Exports consist largely of products manufactured from imported raw materials; Europe is the principal market.

Nickel imported for consumption in the United States, 1936–38, by classes

Class	1936 Pounds	1936 Value	1937 Pounds	1937 Value	1938 Pounds	1938 Value
Unmanufactured:						
Nickel ore and matte	23,194,329	$3,048,966	25,085,947	$3,258,221	14,629,473	$1,952,396
Nickel alloys, pigs, bars, etc	80,537,245	20,265,293	81,745,023	20,306,471	43,906,331	11,022,673
Nickel oxide	2,550,073	477,285	2,044,395	385,644	555,181	94,899
Manufactured:						
Nickel silver or German silver in sheets, strips, rods, and wire					296	219
All other manufactures of nickel	(1)	21,704	(1)	35,668	(1)	19,316
		23,813,248		23,986,004		13,089,503

[1] Quantity not recorded.

Nickel exported from the United States, 1936–38, by classes

Class	1936 Pounds	1936 Value	1937 Pounds	1937 Value	1938 Pounds	1938 Value
Nickel, Monel metal, and other alloys	6,876,594	$3,060,339	7,633,189	$2,685,305	11,842,937	$2,892,423
Manufactures	(1)	3,635,430	(1)	2,464,518	(1)	606,892
Nickel-chrome electric resistance wire	328,749	414,542	494,848	562,693	490,640	552,470
Nickel silver or German silver in bars, rods, or sheets	950,803	144,176	818,539	181,037	794,811	91,290
		7,254,487		5,893,553		4,143,075

[1] Quantity not recorded.

WORLD ASPECTS

World production.—World nickel production in 1938 may be estimated roughly at 109,000 metric tons, or about 5 percent less than in 1937. Canada decreased its output 6 percent but supplied about 88 percent of the total. The output in New Caledonia, the second largest producer, was about the same as in 1937.

World production of nickel (content of ore), 1934–38, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Brazil	39	5	478	104	(1)
Burma	1,228	1,488	1,312	1,233	935
Canada	58,371	62,830	76,992	[2] 102,015	95,559
Egypt				14	(1)
Germany		272	660	890	(1)
Greece	1,063	1,109	1,255	957	(1)
Italy			(3)	68	(1)
Japan		4	24	(1)	(1)
Morocco, French		208	85	132	163
Netherland India					[4] 500
New Caledonia	8,600	6,300	4,964	6,096	6,004
Norway	1,334	1,235	1,455	982	[4] 1,125
Southern Rhodesia		12	14	2	[4] 14
Union of South Africa					45
U. S. S. R.	863	1,829	2,000	2,000	[4] 2,500
United States [5]	142	145	97	199	377
	71,600	75,400	89,300	115,200	(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.—The London Mining Journal (March 4, 1939, p. 173) estimates world consumption of nickel in 1938 as follows:

	Metric tons		*Metric tons*
United States	23,400	Italy	3,600
U. S. S. R.	17,300	Sweden	2,500
United Kingdom	13,200	Czechoslovakia	2,000
Germany (including Austria)	12,200	Other countries	3,100
Japan	9,100		
France	6,100		92,500

The foregoing figures indicate gains over 1937 of 1,000 tons each for Japan, France, and Italy and 500 tons each for Sweden and Germany, but losses of 17,000 tons for the United States, 1,000 tons each for the U. S. S. R. and the United Kingdom, and 500 tons for Czechoslovakia.

REVIEW BY COUNTRIES

Burma.—The nickel produced in Burma is derived from a nickel-bearing speiss made by the Burma Corporation, Ltd., at Namtu in the Northern Shan States. The speiss, containing approximately 30 percent nickel, 8 percent copper, and 7 percent cobalt, as well as 17 ounces of silver to the ton, is shipped to Hamburg for further treatment.

Canada.—Virtually all the 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 105,337 short tons valued at $53,949,311 in 1938 compared with 112,453 tons valued at $59,507,176 in 1937.

The International Nickel Co. of Canada, Ltd.,[4] operated at a slightly reduced scale throughout 1938. Four mines—Frood (3,497,846 tons), Creighton (1,092,155 tons), Levack (814,513 tons), and Garson (380,780 tons)—produced 5,785,294 short tons of ore. Proved ore reserves at all Canadian mines of the company were 212,368,000 tons containing 6,806,000 tons of copper and nickel on December 31, 1938, compared with 6,739,000 tons of copper and nickel in the reserves on December 31, 1937.

The concentrator treated 4,519,652 tons of ore in 1938. The Port Colborne nickel refinery produced 62,117 tons of refined nickel in 1938. Sales of nickel in all forms were 82,189 tons in 1938 (103,850 tons in 1937).

Falconbridge Nickel Mines, Ltd., [5] operated at a higher rate than in 1937 and treated 490,938 tons of ore (438,629 tons in 1937), comprising 252,866 tons of milling ore and 238,072 tons of smelting ore. The ore, which averaged 1.81 percent nickel and 0.95 percent copper in 1938, is smelted in Canada and the matte shipped to Norway for refining. Ore reserves were 6,881,000 tons averaging 1.80 percent nickel and 0.97 percent copper on December 31, 1938, compared with 6,333,000 tons containing 1.82 percent nickel and 0.89 percent copper on December 31, 1937.

Finland.[6]—The mine development program at Petsamo of the Petsamon Nikkeli O/Y is progressing satisfactorily. An adit 8,580 feet long, driven to reach the ore body, was completed in January 1939, and it is expected that the vertical shaft (680 feet deep) will connect with the adit early in 1939. Many of the surface buildings, such as shops, storehouses, and workmen's dwellings, have been built and construction of the smelting plant is actively under way. A hydroelectric power development is under way to provide power for the operation of the Kaulatunturi mine and the smelting plant. Barring unforeseen emergencies the mine, smelter, and hydroelectric power station will begin production by the autumn of 1940.

Germany.[7]—Owing to the low grade of its ore and resultant unprofitable exploitation, Germany's only nickel mine, at Frankenstein, Silesia, remained idle for many years, and its operation was revived only in 1935 and 1936, when it furnished a small output of nickel—200 and 450 metric tons, respectively. In 1937 production was 87,000 metric tons of nickel ores. Intensive exploitation during the World War reduced the nickel content of the Frankenstein deposits from 2.5 to only 1 percent, and it was only with the development of the improved "Renn" process by the Krupp Co. that a resumption of exploitation of the deposits was made practicable in 1935. Availability of the Renn process has caused interest to be revived in nickel deposits in other parts of Germany, notably those at Horbach near St. Blasien, Baden.

Japan.—Since Japan has been making all possible efforts to be independent of imports of nickel, reports frequently have appeared in the press of the discovery of deposits supposed to be of such richness and extent as to challenge the supremacy of the Sudbury district (Ontario), but such reports no doubt reflect wishes rather than actual discoveries.

[4] International Nickel Co. of Canada, Ltd., Annual Report, 1938.
[5] Falconbridge Nickel Mines, Ltd., 10th Annual Report, 1938.
[6] International Nickel Co. of Canada, Ltd., Annual Report, 1938.
[7] Redecker, S. B., American consul, Frankfort on the Main, Germany, May 14, 1938.

The Nippon Nickel Co. is the only firm in Japan to refine metallic nickel from domestic ores.[8] It is reported that company prospectors recently discovered a deposit of 2 to 3 percent ores. Those currently worked contain only 0.3 to 0.88 percent nickel.

The Nippon Kogyo Kaisha is producing nickel by importing the ore from New Caledonia.

The Toho Kinzoku Seiren Kabushiki Kaisha has been organized and plans to erect a refining plant capable of producing 2,100 metric tons of nickel and 20 tons of cobalt annually. Nickel ore will be obtained from Southern Rhodesia.[9]

Netherland India.—It is reported [10] that the Oost-Borneo Maatschappij has shipped about 20,000 tons of nickel ore from the newly opened Celebes mines to Krupp in Germany, where the ore is to be tested for its adaptability for treatment by certain metallurgical processes.

New Caledonia.—Exports of crude ore (4 to 6 percent nickel content) increased to 30,810 metric tons in 1938 from 17,960 tons in 1937, but shipments of matte (about 77 percent nickel content) declined to 5,932 metric tons from 6,830 tons. Figures for 9 months indicate that Japan took nearly 55 percent and Germany 45 percent of the ore exported in 1938; a small amount went to Belgium. All the matte was shipped to France and Belgium.

Norway.—The Falconbridge refinery at Kristiansand operated steadily and normally throughout 1938 on matte from the Falconbridge smelter near Sudbury, Ontario, Canada, and on some custom matte. It produced 8,213 short tons of nickel (7,429 tons in 1937) and 4,125 tons of copper (3,820 tons in 1937). In 1938 sales of nickel were 7,142 tons (6,621 tons in 1937) and of copper 3,854 tons (3,115 tons in 1937).

Southern Rhodesia.—According to the Mining Journal: [11]

> Nickel was produced in small quantities from the Noel Nickel Mine, Gwanda. This property is now being worked by a strong mining company, and it is the intention of the company to put in a production plant with a capacity of from 200 to 300 tons of ore per day. Meanwhile, the fuller prospecting and development of the property is being pushed ahead with all speed.

Union of South Africa.—The new plant at Rustenburg Platinum Mines, Ltd., which began operation in 1937, produced matte containing 40 percent nickel, 25 percent copper, and 35 ounces of precious metals per ton in 1938.[12]

U. S. S. R.[13]—During the past 5 or 6 years Soviet geologists and mining engineers have been prospecting the Kola Peninsula, the Moncha district in particular. Deposits of iron, copper, and nickel ores, as well as occurrences of gold, platinum, cobalt, and other metals, were located. Especially interesting nickel ore deposits, said to be very rich, have been found in two localities called Nittis and Kumujie. Construction of a plant for refining this ore was started a few years ago at Monchagorsk (the town of Moncha); it was completed in October 1938 and has started to produce nickel. It can produce 2,500 tons of metal annually, provided a daily supply of 500 tons of ore is available. The present state of nickel ore mining in

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[8] Mining Journal (London), vol. 203, Dec. 31, 1938, p. 1204.
[9] Warner, Gerald, American consul, Taihoku, Taiwan, Japan, Aug. 27, 1938.
[10] American Metal Market, vol. 45, Oct. 19, 1938, p. 7.
[11] Mining Journal (London), vol. 204, Mar. 4, 1939, p. 196.
[12] Metal Bulletin (London), No. 2295, June 3, 1938, p. 4.
[13] Metal Industry (London), vol. 53, Nov. 25, 1938, p. 526.

the Nittis-Kumujie district has been disappointing, however, and instead of the 500 tons contemplated, hardly 200 tons daily are being mined.

The refinery at Ufalei, opened 4 years ago, produces some 1,500 tons of nickel per annum. A third refinery will be constructed in the South Urals district, where nickel ore deposits are considered by the Soviet experts to be of very rich nickel content.

United Kingdom.—The Clydach nickel refinery of the Mond Nickel Co., Ltd., produced 21,981 short tons of nickel in the form of pellets in 1938 (19,777 tons in 1937) and 1,224 tons of nickel in salts (1,215 tons in 1937).

COBALT

Consumption of cobalt in the United States in 1938, as indicated by imports, declined substantially; and, as in the past, the demand was supplied entirely by imports, as there was no domestic output. Total imports decreased about 28 percent. Despite the decreased demand, domestic quotations were unchanged—97 to 99 percent metal from Belgium in lots of 100 pounds or more was $1.36 a pound and black oxide (70 to 71 percent grade) in lots of 350 pounds or more, $1.67 a pound.

World production may be roughly estimated at 4,500 metric tons in 1938 compared with 3,800 tons in 1937. Outputs in Burma and Canada declined moderately, but production in French Morocco and Northern Rhodesia increased substantially. A small quantity was produced in Chile in 1938.

World consumption of cobalt was estimated by the London Mining Journal (Mar. 4, 1939, p. 175) at 3,100 tons in 1938 compared with 3,000 tons in 1937.

PRODUCTION

There was no marketed production of cobalt from domestic deposits in 1938. A western electrolytic-zinc plant recovered 16 short tons of residue containing 3.3 percent cobalt, but no shipments were made.

The United States, a large consumer of cobalt, has thus far failed to develop substantial supplies, but recent developments raise the hope that this country may yet produce cobalt in commerical quantities. Experiments on recovery of cobalt from the iron ores mined at Cornwall, Pa., were carried on during 1938. Cobalt, which has long been known to occur as a minor constituent of these iron ores, has been found in increased amounts in the ore bodies now being mined. Substantial values in cobalt, nickel, and platinum have been reported discovered associated with the molybdenite near Porthill, Boundary County, Idaho, and two flotation machines to separate these metals have been installed. In the Tombstone district, Ariz., development was continued in 1938 on a prospect from which a small quantity of ore reported to contain 1 to 7 percent cobalt was produced (but not sold) in 1937. Near Keating, Oreg., development was in progress at a deposit reported to contain cobalt and nickel.

FOREIGN TRADE

A feature of the import trade in 1938 was the marked increase in receipts of metal from Canada and Finland and receipts of 17,783 pounds of ore from the recently reopened mines in Chile. After advancing progressively for several years, imports of cobalt dropped considerably in 1938. Total imports of cobalt decreased approximately 28 percent in 1938 compared with 1937. Imports of ore declined 23 percent, metal 13 percent, and oxide 56 percent. Exports of cobalt 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, 1937–38, by countries, in pounds

Country	Ore		Metal		Oxide	
	1937	1938	1937	1938	1937	1938
Australia	8,120					
Austria			154	[1] 33		
Belgium			916,749	617,088	301,000	22,050
Canada	579,379	432,201	8,426	80,779	90,310	
Chile		17,783				
Finland			147,800	240,575	109,550	89,250
France					74,480	120,540
Germany				[1] 1	267,507	141,375
	587,499	449,984	1,073,129	938,476	842,847	373,215

[1] Austria included with Germany, beginning May 6, 1938.

Cobalt ore, cobalt (metal), oxide, and other compounds of cobalt imported for consumption in the United States, 1935–38

	1935		1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Cobalt ore	419,110	$46,608	1,039,760	$77,965	587,499	$44,352	449,984	$32,354
Cobalt (metal)	563,866	630,289	883,377	1,014,965	1,073,129	1,341,928	938,476	1,146,559
Oxide	557,083	503,445	813,642	885,566	842,847	1,059,432	373,215	519,201
Sulfate	80,082	23,333	46,472	16,502	56,540	21,858	41,811	18,277
Other salts and compounds	472	679	186	277	45	187	56	98

USES

Increasing world production, assurance of adequate supplies, and extensive research investigations have been important factors in expanding the use of cobalt. Cobalt oxide is used in the ceramic industry and as a catalyst; cobalt salts in the preparation of driers for use in paints, varnishes, and linoleums; and cobalt metal in various types of high-grade steels (especially metal-cutting and magnet steels), as a catalyst, and in electroplating processes.

According to the London Mining Journal (Mar. 4, 1939, p. 175) the cobalt industry maintained its position during 1938 chiefly because of the demand for the metal in the catalytic synthesis of hydrocarbons from mixtures of carbon monoxide and hydrogen, for which purpose it is extensively used in the Fischer-Tropsch reaction to give a wide range of *n*-paraffins. The metals that form the basis of active catalysts for the Fischer-Tropsch reaction are iron, nickel, and cobalt.

Special cobaltized salt for incorporation in salt licks for cattle and sheep is now being prepared in New Zealand.[14] It contains 4 ounces

[14] Bulletin of the Imperial Institute, vol. 36, London, October-December 1938, p. 511.

of cobalt sulfate to 18¾ pounds of salt, with 1 pound of hematite added to color it bright red. This is intended to be used at the rate of 1 pound to 1 hundredweight of agricultural salt, the red color forming a guide to the completeness of the mixing.

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 on total world output. Estimating the output of Belgian Congo very roughly at 1,500 metric tons in 1938, world production of 4,500 tons is indicated. Substantial increases in production were recorded in French Morocco and Northern Rhodesia, but output declined moderately in Burma and Canada.

The chief cobalt deposits of the world are described briefly in a recent article by More.[15]

World production of cobalt, 1936–38, in metric tons

[Compiled by M. T. Latus]

Country [1]	Cobalt-bearing material	1936		1937		1938	
		Gross weight	Cobalt content	Gross weight	Cobalt content	Gross weight	Cobalt content
Belgian Congo	Cobaltiferous copper ore	(2)	685	(2)	1,500	(2)	(2)
Bolivia	Cobalt ore				5	(3)	(2)	(2)
Burma [4]	Cobaltiferous nickel speiss	[5] 4,669	214	4,389	298	3,399	238
Canada: Ontario	Cobalt, alloys, and chemicals	(2)	403	(2)	230	(2)	208
Morocco, French	Cobalt ore [6]	3,370	371	5,280	581	6,540	719
Northern Rhodesia	Cobaltiferous copper ore	(2)	461	(2)	884	(2)	1,461

[1] In addition to the countries listed, Chile, China, Finland, Germany, 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] In addition, 5 tons of cobalt ore containing 14.4 percent cobalt and 5 tons of speiss containing 22.13 percent cobalt were reported from Nepal during the calendar year.
[6] Average cobalt content estimated at 11 percent.

Belgian Congo.—The Belgian Congo is one of the largest sources of cobalt, but accurate details of production are not available. The copper ores that contain cobalt are divided into two classes. One type, containing about 4 percent cobalt and 18 percent copper and iron, is treated in a water-jacketed furnace and an electric furnace to give a ternary alloy containing 30 percent cobalt, 40 percent iron, and 26 percent copper. The other class of ore is rich in cobalt and is sent directly to the electric furnace to obtain the same type of product.

Production of cobalt by the Union Minière du Haut Katanga was 1,500 metric tons in 1937 compared with 685 tons in 1936.[16] The cobalt-producing capacity of Union Minière du Haut Katanga has been increased considerably by the discovery of further reserves of rich cobalt minerals.[17] A fourth electric furnace for the treatment of cobaltiferous minerals has been installed at the Jabotville-Panda works.

[15] More, Ch., Le Cobalt: Minerais et sources naturelles. (Cobalt: Ores and Natural Sources): Mines, Carrières, vol. 17, Paris, June 1938, pp. 1–4; July 1938, pp. 5, 7.
[16] South African Mining and Engineering Journal, vol. 49, pt. 1, May 28, 1938, p. 427.
[17] South African Mining and Engineering Journal, vol. 49, pt. 1, Sept. 17, 1938, p. 72.

Burma.—Cobalt production of Burma is derived 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. It is shipped to Hamburg for treatment.

Canada.—Canadian production of cobalt includes the cobalt in ores and concentrates exported from northern Ontario, cobalt metal produced by the Deloro Smelting & Refining Co., Ltd., Deloro, Ontario, and the cobalt contained in cobalt oxide produced by the same company. The total output amounted to 459,060 pounds valued at $788,576 in 1938 compared with 507,064 pounds valued at $848,145 in 1937.[18] Exports of cobalt alloys, metal, oxides, and ores were valued at $765,580 in 1938 compared with $909,140 in 1937.

Increased amounts of cobalt and nickel minerals have been reported found on the lower mine levels at Great Bear Lake, Northwest Territories.[19]

Chile.—A small production of cobalt was reported in Chile in 1938. According to Faust: [20]

> During the period between 1899 and 1906, three small mines, known as Rosa Amelia, Blanca, and Despreciada, near Puerto del Huasco in the Province of Atacama, produced 905 metric tons of hand-picked cobalt ore averaging 6.37 percent cobalt. About 18 months ago, the Compañia Minera "La Cobaltera" began to reopen the mines. The company expects to make its first shipment in June, the shipment to consist of 14 to 18 tons of hand-picked mineral containing approximately 12 percent of sulfarsenide of cobalt (cobaltite, CoAsS).
>
> Various pockets of ore containing up to 18 percent cobaltite have been opened, but the average material as it comes from the mine contains approximately 1.75 percent cobalt and 0.30 percent nickel. The company expects to concentrate 20 tons of this ore by the gravimetric method to obtain approximately 3 tons of 15 percent material daily. The flotation method will be adopted at a later date.
>
> There are at present three shafts—118, 49, and 47 meters deep. Sixty-eight workmen are now employed, and it is understood that this force will be increased in the near future.

Finland.—Finland became a producer of cobalt recently, but figures on output are lacking. Imports of cobalt metal into the United States from Finland increased to 240,575 pounds in 1938 compared with 147,800 in 1937.

In the Outokumpu copper mine, in eastern Finland, approximately 0.2 percent cobalt, 0.1 percent nickel, and 26 percent iron are associated with a 4-percent copper ore.[21] Prior to 1936 the copper concentrates were exported, but they are now sent to the smelter erected at Imatra in southern Finland.

Germany.—Output of cobalt in Germany will be increased by the resumption of operations of an old mine at Schneeberg, Saxony, formerly an important cobalt producer, as well as by exploitation of cobalt deposits in Wittichen and in the southern Black Forest, according to a report submitted by the American consulate general at Frankfort on the Main under date of May 14, 1938. In recent years Germany's production of cobalt, amounting to about 17 metric tons annually, was obtained as a byproduct of the Mansfeld copper shale deposits in Central Germany, but with the now developing exploitation of these cobalt deposits, output will suffice to supply the great bulk of Germany's requirements of around 100 metric tons a year.

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[18] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada during the Calendar Year 1938: Ottawa, 1939.

[19] Mining Journal (London), vol. 203, Aug. 13, 1938, p. 774.

[20] Faust, J. B., American consulate general, Santiago, Chile, May 27, 1938.

[21] Mäkinen, Eero, Outokumpu Copper Mine and Smelter, Finland: Min. and Met., vol. 19, February 1938, pp. 85–91.

Morocco, French.—Cobalt made its first appearance in the mineral statistics of French Morocco in 1932, when 63 metric tons were recovered. Since that time production has advanced almost steadily and reached a peak of 719 metric tons in 1938.

Northern Rhodesia.—The Rhokana Corporation, Ltd., sold 831 short tons of cobalt in alloys and refined products during the year ended June 30, 1938, compared with 730 tons during the corresponding year 1937. Production increased to 1,461 metric tons in the calendar year 1938 compared with 884 tons in 1937. A third electric furnace, increasing capacity for treating converter slags by 50 percent, was added to the cobalt plant. A plant for the differential flotation of copper and cobalt to obtain a rich cobalt concentrate has also been installed.

MOLYBDENUM, TUNGSTEN, AND VANADIUM

By Robert H. Ridgway and H. W. Davis [1]

SUMMARY OUTLINE

MOLYBDENUM

The output of molybdenum, unlike that of most other industrial metals, increased in 1938, thereby continuing its remarkable progress. Although record production figures were established, consumption was not as high as in 1937, when record steel output plus extensive armament activities pressed production facilities to meet demand. In consequence, some stocks accumulated at mines during 1938. In this country, the predominant producer, output of molybdenum in the form of concentrates exceeded shipments by 7,500,000 pounds—an amount equivalent to about 30 percent of the total shipments. Stocks at the beginning of 1938, however, were small.

Of the record world output of 36,000,000 pounds of molybdenum in 1938, the United States supplied 33,297,000 pounds (92.5 percent); thus, the United States furnishes the bulk of the world's molybdenum. The relatively small amount produced by other countries came mainly from Mexico and Norway; output in Mexico was less in 1938 than in 1937, but production in Norway increased. Molybdenum is one of the few ferro-alloying elements of which this country has ample supplies for its own needs.

Exports of molybdenum from the United States are not known exactly, since they are not classified separately in trade statistics, but they are believed to comprise 50 to 75 percent of the domestic production.

The Climax mine of the Climax Molybdenum Co. is the principal producer of molybdenum, having furnished about 78 percent of the world output and 85 percent of the domestic output in 1938. New capacity added in 1937 permitted 12,000 short tons of ore to be milled per day in 1938. Output of molybdenite concentrates from the copper ores of the Utah Copper Co. at Bingham, Utah, and of

[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 Nevada Consolidated Copper Corporation at Chino, N. Mex., continued during the year. As this output is entirely byproduct and depends on the rate of copper operation, production dropped in 1938. Of interest during the year were the initial production and shipment of molybdenite concentrates from the copper operations of the Miami Copper Co., Miami, Ariz.

Activities in the search for and development of molybdenum deposits in various parts of the world continued in 1938.

Salient statistics of the molybdenum industry in the United States, 1936–38 [1]

	1936	1937	1938
Production:			
Ore ... short tons	2,269,000	[2] 3,638,000	[2] 4,601,000
Concentrates ... do	17,686	30,357	36,157
Molybdenum contained:			
Average ... percent	48.59	48.46	46.05
Total ... pounds	17,186,000	29,419,000	33,297,000
Shipments (molybdenum contained):			
Pounds	17,959,000	30,122,000	25,727,000
Value [3]	$11,933,000	$20,571,000	$17,977,000
Imports (molybdenum contained):			
Pounds	49	7,707	25
Value	$213	$13,491	$81

[1] Figures for molybdenum exported not separately recorded.
[2] Excludes copper ore yielding molybdenite concentrates from New Mexico and Utah in 1937 and Arizona, New Mexico, and Utah in 1938.
[3] Estimated by Bureau of Mines.

PRICES

Prices for molybdenite concentrates carrying 90 percent MoS_2 were quoted nominally by the Engineering and Mining Journal at 42 cents per pound of contained MoS_2 from January 1, 1938, until late in March, when the quotation rose to 45 cents where it remained for the rest of the year; however, London prices for the same grade of concentrates decreased during the year. In January 1938 the quotations were 47s. per long ton unit. Lower quotations reduced the figure to 41–42s. late in December. This price drop was equivalent to a decrease from 52 cents per pound in January to 43 cents in October.

DOMESTIC PRODUCTION

Alaska.—The Kennecott Copper Corporation abandoned its development work on the molybdenum prospect near Valdez in the Copper River Valley during 1938.

Arizona.—Five mines in Arizona produced 4,784 short tons of concentrates containing 1,139,593 pounds of molybdenum in 1938.

The largest producer, the Arizona Molybdenum Corporation, which operates a property near Mammoth, Pinal County, treated 79,333 short tons of ore during 1938, from which 537 tons of concentrates containing 607,605 pounds of molybdenum were recovered. The mine was shut down late in the year, but the mill continued to operate on the tailings supply. The reopening of the mine will depend on results of further exploration and development.

The Molybdenum Gold Mining Co., a subsidiary of the Molybdenum Corporation of America, continued to mine complex ore from the oxide zone in the Mohawk and New Year claims near Mammoth. The mine-run ore goes to the nearby mill of the Mammoth-St. Anthony, Ltd., where gold, silver, lead, molybdenum, and vanadium are recovered by selective flotation. The latter company also treats a similar ore from its nearby Mammoth mine. In 1938, the mill produced 4,191 short tons of concentrates containing 481,156 pounds of Mo. The geology and ore deposits of this area have been described by Peterson.[2]

The Miami Copper Co. reported the recovery and shipment in 1938 of a small quantity of molybdenite concentrates resulting from the re-treatment of copper sulfide concentrates at Miami, Gila County.

Colorado.—The Climax Molybdenum Co., the world's largest producer of molybdenum, operated its mine and mill at capacity throughout 1938, having mined 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. Production exceeded shipments, permitting some stock of concentrates to be built at the mine. Output at this property has increased nearly six times during the past 6 years, as shown in the following table.

Molybdenum (element) contained in concentrates produced from the Climax deposit, Colorado, 1933–38

	Pounds		Pounds
1933	5, 028, 695	1936	15, 216, 806
1934	8, 378, 683	1937	22, 750, 368
1935	10, 168, 635	1938	28, 242, 085

The building program, which included mill enlargement, hotel, hospital, houses for employees, street work, and sewer and water-pipe installation, was completed early in 1938.[3]

Other development work and discoveries were reported from Colorado in 1938, but Climax was the only producer.

Idaho.—The International Molybdenum Co. made a small production, but no shipments, in connection with the development of its property near Porthill in Boundary County. Additional flotation equipment was installed in 1938. The ore at this property also contains values in nickel, cobalt, and platinum.

Nevada.—No production or shipment of molybdenum was recorded for Nevada in 1938, but development work on several deposits was reported.

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 low. Development work on lower levels is reported to be giving encouraging results. The geology and ore deposit have been described by Vanderwilt.[4]

Molybdenite concentrates also were produced by the Nevada Consolidated Copper Corporation at the Chino property in the treatment of copper ores.

Utah.—All production in 1938 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

[2] Peterson, N. P., Geology and Ore Deposits of the Mammoth Mining Camp Area, Pinal County, Ariz.: University of Arizona, Arizona Bureau of Mines Bull., vol. 9, No. 2, April 1, 1938, pp. 1–63.
[3] Richardson, J. K., A Modern Hospital Serves Climax Camp: Eng. and Min. Jour., vol. 139, No. 11, November 1938, pp. 36–38.
[4] Vanderwilt, J. W., Geology of the "Questa" Molybdenite Deposit, Taos County, N. Mex.: Proc. Colorado Sci. Soc., vol. 13, No. 11, 1938, pp. 599–643.

concentrates produced are entirely byproduct and fluctuate with the output of copper, thus output was lower in 1938 than in 1937. A material improvement in recoveries, however, explained in large degree the smaller proportionate decline in the production of molybdenite compared with copper.

Washington.—The Deertrail Monitor Mines Co. mined about 3,000 short tons of ore at its Monitor mine on Adams Mountain 6 miles east of Fruitland, Stevens County. About 300 tons were milled in the 50-ton flotation mill, from which 3 tons of concentrates were recovered; 5 tons were shipped. Three other concerns—the Copper Mining Co., the Consolidated Mines & Smelting Co., Ltd., and the American Rand Corporation—produced ore in connection with development operations, but the ore was not concentrated, and there were no shipments.

IMPORTS AND EXPORTS

Exports of molybdenum, principally in the form of concentrates, provide an important outlet for the domestic molybdenum industry. Data are not available, since molybdenum is not classified separately in export statistics; but it appears that 50 to 75 percent of the domestic production is exported. 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, 1934–38

Year	Molybdenum content (pounds)	Value	Year	Molybdenum content (pounds)	Value
1934	213,928	$124,156	1937	7,707	$13,491
1935	68,758	40,721	1938	25	81
1936	49	213			

In addition to the quantity shown in the above table 139,535 pounds of ore and concentrates containing 91,905 pounds of molybdenum valued at $41,586 were imported for smelting, refining, and export in 1938 compared with none in 1937. Of the 1938 figure 136,200 pounds containing 90,442 pounds of Mo valued at $40,780 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 application both in new outlets and as a substitute for and an addition to other alloying elements. Molybdenum may be used alone to impart certain desired properties to iron and steel, but more frequently it is used with one or more of the other ferro-alloying elements.

For most purposes molybdenite (MoS_2), the principal mineral raw material, is converted, before using, to ferromolybdenum (a product carrying 60 to 65 percent molybdenum) or to calcium molybdate (a compound resulting from the roasting of molybdenite with lime and containing 35 to 45 percent molybdenum). The latter is the cheaper method of preparing molybdenum for industrial applications. Molybdenum oxide in briquets is also used in making molybdenum additions to iron and steel.

Improved processes of heat-treating and fabricating high-speed tool steels, in which part of the tungsten has been replaced by molybdenum, have increased the use of molybdenum in this field. Molybdenum is also being employed more generally in stainless steels of the 18–8 type.

Molybdenum compounds find limited use in nonmetallics, but consumption is not large.

WORLD PRODUCTION

World production of molybdenum comes from only a few mines. Operations in Mexico, Norway, and the United States furnish the bulk of the world requirements. The search for new sources continued during 1938; but, so far as is known, there were no significant developments.

World production of molybdenum ores and concentrates, 1934–38, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Australia:					
New South Wales (concentrates)	3	--------	(1)	16	(2)
Queensland (concentrates)	1	11	20	23	14
Victoria (concentrates)	--------	--------	--------	31	36
Burma	--------	--------	--------	(1)	(2)
Canada (concentrates)	--------	--------	--------	7	--------
China (ore containing 45 percent Mo)	2	(2)	(2)	(2)	(2)
Chosen (ore)	104	106	80	(2)	(2)
Italy (ore)	--------	--------	861	46	(2)
Japan (dressed ore)	5	6	7	(2)	(2)
Mexico (Mo content)	467	687	534	629	483
Morocco, French (concentrates) [3]	149	190	187	195	258
Norway (Mo content)	146	388	422	344	450
Peru (concentrates)	15	13	19	83	153
Rumania (Bi-Mo ore)	6	14	46	27	(2)
Turkey (ore)	--------	--------	--------	43	(2)
United States (Mo content)	4,247	5,222	7,795	13,344	15,103
Yugoslavia	--------	18	--------	84	19

[1] Less than 1 ton.
[2] Data not available.
[3] Exports.

Canada.—In 1938 the Zenith Molybdenite Corporation, formerly the Phoenix Molybdenite Corporation, Ltd., Renfrew County, Ontario, reported shipment to England and France of 7 metric tons of concentrates valued at $4,500; these had been produced in 1937. Prospectors have been active recently both in prospecting and developing molybdenite properties in Ontario.

Mexico.—Output, which was lower in 1938 than in 1937, comes principally from the Greene Cananea Copper Co., where molybdenite concentrates are recovered as a byproduct in the treatment of copper ores. Mine and reduction works at Cananea were closed by a strike during the latter half of September; then a 2-year labor contract was signed.

Morocco, French.—French Morocco is the largest producer in Africa. Much of the output comes from the mine of the Société le Molybdène near Azegour. A discovery of deposits in the Haut-Tifnout region near the Souss valley recently has been reported.[5]

[5] Metal Bulletin (London), The Tifnout Deposits: No. 2369, February 24, 1939, p. 16.

Norway.—The Knaben Mölybdan Gruber was the only producer in Norway in 1938. Output was larger than in 1937. A concentrating plant was being installed at the Laxadalen Molybdängruber at Gildeskal, northern Norway, but no output has yet been recorded.

Turkey.—Production of molybdenum in Turkey is small, but shipments were made to the United States in 1938.

TUNGSTEN

Interest in the tungsten industry in 1938 continued to be centered chiefly on conditions in China, the principal source, but the effect of hostilities was not as pronounced as in 1937. Japanese gains in 1938 did not give them control of the tungsten-producing areas; but the railroad through South China to Canton and Hongkong, the main route of flow after the capture of Shanghai in 1937, fell to the invaders late in 1938. Tungsten concentrates in reduced quantities continued to move out, however, principally through Swatow, and this movement together with supplies available from other sources and lessened demand eased the tungsten situation in 1938.

Apparently the United States was the second largest producer in 1938, and domestic output was 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 production from domestic mines increased over 1937, shipments declined, resulting in some stock at mines or mills. The development and reequipment of properties continued in the Western States, and activities around Bishop, Calif., attracted attention during 1938. As the year progressed, however, there was some curtailment in the domestic industry.

Salient statistics of the tungsten industry in the United States, 1937–38

	1937		1938	
	Short tons	Value	Short tons	Value
Production (60 percent WO_3)	3,500	(1)	4,000	(1)
Concentrates shipped (60 percent WO_3)	3,500	$4,094,000	3,044	$3,161,498
Imported for consumption (W content)	2,848	3,073,612	81	138,693
Stocks in bonded warehouses, Dec. 31:				
Ore (W content)	401	707,350	326	602,376
Metal (W content)	4	9,447	10	24,182

[1] Figures not available.

Strategic reserve.—Tungsten is listed as a strategic commodity, but the position of the United States with regard to this essential metal is far less vulnerable than that with respect to manganese, tin, or chromium. Under the tariff the industry has continued, and this protection together with the high world prices maintained in recent years have resulted in a large measure of self-sufficiency. No purchases for strategic stock-pile purposes ~~have~~ been made by the Navy Department in connection with its limited program during the last 2 years. ~~The tungsten situation~~, however, is being studied thoroughly in connection with probable purchases should appropriations in legislation now pending become available. The following tables present the historical background for consideration of the strategic nature of tungsten.

Domestic shipments, imports, exports, and apparent consumption of tungsten in the United States, 1910–38, in thousands of pounds of metal

Year	Shipments	Imports [1]	Exports [1]	Apparent consumption	Year	Shipments	Imports [1]	Exports [1]	Apparent consumption
1910	1,733	1,941	89	3,585	1925	1,133	1,694	10	2,817
1911	1,084	446	(2)	1,530	1926	1,315	2,884	24	4,175
1912	1,266	1,542	(2)	2,808	1927	1,108	2,198	16	3,290
1913	1,463	2,047	(2)	3,510	1928	1,150	2,969	13	4,106
1914	942	775	(2)	1,717	1929	790	6,446	82	7,154
1915	2,219	1,848	(2)	4,067	1930	668	3,998	24	4,642
1916	5,637	4,304	615	9,326	1931	1,336	189	846	679
1917	5,847	5,054	2,489	8,412	1932	377	106	113	370
1918	4,817	12,233	1,319	15,731	1933	852	379	683	548
1919	311	10,388	41	10,658	1934	1,950	954	563	2,341
1920	206	4,203	5	4,404	1935	2,279	892	798	2,373
1921	--------	2,257	--------	2,257	1936	2,486	3,767	[3] 104	6,149
1922	--------	2,908	1	2,907	1937	3,331	5,696	(2)	9,027
1923	229	79	4	304	1938	2,897	162	(2)	3,059
1924	538	142	3	677					

[1] Partly estimated.
[2] Figures not available.
[3] Complete data not available.

Concentrated tungsten ores (reduced to equivalent of 60 percent of tungsten trioxide), produced in the United States, sold in 1910–38, by States, in short tons

Year	Arizona	California	Colorado	Idaho	Nevada	South Dakota	Washington	Other States [1]	Total
1910	17	480	1,221	--------	--------	(2)	103	--------	1,821
1911	50	314	730	22	22	--------	1	--------	1,139
1912	27	462	812	20	8	--------	--------	1	1,330
1913	16	541	953	14	3	1	1	8	1,537
1914	15	489	467	9	--------	--------	--------	10	990
1915	127	962	963	32	55	140	1	52	2,332
1916	218	2,171	2,401	101	689	239	11	93	5,923
1917	150	2,781	2,707	2	143	270	10	81	6,144
1918	213	1,791	1,910	--------	898	201	1	47	5,061
1919	50	147	130	--------	--------	--------	--------	--------	327
1920	--------	--------	216	--------	--------	--------	--------	--------	216
1921	--------	--------	--------	--------	--------	--------	--------	--------	--------
1922	--------	--------	--------	--------	--------	--------	--------	--------	--------
1923	--------	--------	241	--------	--------	--------	--------	--------	241
1924	--------	219	123	--------	117	106	--------	--------	565
1925	9	574	201	--------	407	--------	--------	--------	1,191
1926	25	490	232	--------	545	90	--------	--------	1,382
1927	2	307	332	--------	372	141	--------	10	1,164
1928	--------	(3)	229	--------	551	(3)	--------	428	1,208
1929	20	(3)	152	--------	(3)	5	--------	653	830
1930	1	(3)	47	--------	(3)	--------	(3)	654	702
1931	98	(3)	98	--------	(3)	--------	(3)	1,208	1,404
1932	62	(3)	--------	--------	241	--------	(3)	93	396
1933	42	174	86	--------	550	--------	43	--------	895
1934	(3)	(3)	342	1	1,044	--------	164	498	2,049
1935	394	(3)	390	--------	1,219	--------	192	200	2,395
1936	489	(3)	180	11	1,631	--------	48	253	2,612
1937	349	577	219	99	2,153	--------	64	39	3,500
1938	37	839	240	154	1,461	--------	303	10	3,044

[1] Alaska, Connecticut, Missouri, Montana, New Mexico, Oregon, and Utah, and States indicated by "3".
[2] Less than 1 ton.
[3] Bureau of Mines not at liberty to publish figures.

The following information regarding domestic sources is quoted from a Report upon Certain Deficient Strategic Minerals by the staffs of the Geological Survey and the Bureau of Mines.

Sources.—Most tungsten deposits are tabular bodies that either persist downward to great depths in the earth (veins) or are localized and nearly horizontal (replaced beds). Two minerals, scheelite (containing 63.9 percent tungsten) and wolframite (containing 60.7 percent tungsten) are the source of almost all tungsten. Only a few ores treated to recover tungsten yield other metals, so that tungsten is rarely a byproduct.

Tungsten minerals are rather widespread in the United States, but most of the attempts at commercial production are confined to 11 Western States, and 3 (Nevada, California, and Colorado) currently yield more than 90 percent of the production. As the prices offered for tungsten ores have fluctuated more widely than those for the other strategic metals, the yield from the several districts, as well as the total for the United States, has also fluctuated widely. There can be hardly any doubt that some deposits have become exhausted at depths that range from 500 to 1,000 feet, and that elsewhere, even though the tungsten mineral persists, costs of production have increased.

Since 1900 the United States has imported some tungsten in the form of ore or alloys each year, and even though production has nearly equaled or even exceeded apparent consumption during a few years, dependence on foreign sources has tended to increase. A tariff was first imposed in 1909, and the latest act of 1930 provides for 50 cents per pound on the tungsten in ore and concentrate and as much as 60 cents per pound plus 50 percent ad valorem on metallic tungsten. This is higher than at any previous time. Most of the imported tungsten is in the form of ore or concentrate, and 80 percent or more is derived from China, which is the principal world source. During the past 5 years (1933–37) domestic production has been about half of the apparent consumption.

Production from domestic mines.—Since 1926, production of tungsten in Nevada has exceeded that of any other State, and one mine, discovered in 1917, is now the principal source in the United States. This mine derives its ore from an altered bed of limestone which contains about 1¼ percent of disseminated scheelite. This type deposit is now known to exist widely in western Nevada and southeastern California, and it is probable that other important deposits of similar nature will be found. Although mine operations rarely explore such deposits far in advance of mining and definite figures can rarely be assigned to reserves, the number and widespread distribution of the deposits seem to assure current production for a decade or more.

Numerous tungsten deposits have been explored in California, but one mine (Atolia), near Randsburg, now mining 1,400 feet below the surface, has yielded from 60 to 95 percent of the tungsten output of the State since 1909. Nearby placers have yielded considerable concentrate also. Promising, but low-grade, deposits have been extensively explored near Bishop and elsewhere.

Tungsten-bearing veins have been explored in several parts of Colorado, but a few mines in a single district (Nederland, Boulder County) have yielded nearly all of the output from the State. One mine has attained a depth of approximately 900 feet, but most of the product has been mined within 500 feet of the surface, because veins are narrow and costs increase rapidly with depth.

Even though many tungsten deposits have been explored in the eight other western States, as well as in Missouri and Connecticut, existing records indicate that shipments can be made only during times of high prices.

PRICES

The quotations on tungsten ore or concentrates continued the decline that began in the last quarter of 1937. The low point was reached in May, after which there was some recovery, but the market was weak for the rest of 1938. The fear of stoppage of concentrates from China due to Japanese control over the routes of transportation was a bullish factor, but apparently this was counteracted by availability of supplies from other sources and by reduced demand. London prices for Chinese wolframite concentrates containing 65 percent WO_3, as given by the Mining Journal (London), were highest at the beginning of the year, when the quotation was 78s.–80s. The quotations declined steadily until May, when the average for the month was 37s. 1d. Subsequently the quotation rose until the last quarter, when there were minor fluctuations. The average quotation for December was 54s. 5½d. According to the Engineering and Mining Journal domestic scheelite quotations, f. o. b. New York, for concentrates containing 65 to 70 percent WO_3, followed somewhat the same pattern, opening the year at $22–$25 per short-ton unit declining to \$16–\$20 in May, with the closing quotation at \$20. The quantity of concentrates shipped from China on barter arrangements was not without effect on the tungsten quotations.

DOMESTIC PRODUCTION

Higher prices in 1937 and early 1938 stimulated activities in the domestic tungsten industry, particularly in California, but lower prices later in the year curtailed operations, and a number of properties closed. Although production of concentrates increased shipments declined, resulting in accumulation of some stocks at the mills. Output—the highest recorded in peacetime—came from a rather large number of widely scattered locations, and shipments were made from nine States (Arizona, California, Colorado, Idaho, Missouri, Nevada, New Mexico, 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 maintained. This situation, however, depends on tariff, which at present amounts to \$7.931 per short-ton unit of WO_3 on ore and concentrates.

Concentrated tungsten ores (reduced to equivalent of 60 percent WO_3*) produced in the United States, sold in 1934–38, and average price per unit*

Year	Short tons	Value	Average price per unit	Year	Short tons	Value	Average price per unit
1934	2,049	\$1,791,316	\$14.57	1937	3,500	\$4,094,000	\$19.50
1935	2,395	1,921,017	13.37	1938	3,044	3,161,498	17.31
1936	2,612	2,323,818	14.83				

Gravity concentration generally is used in beneficiating tungsten ores. In crushing ore for concentration there is considerable pulverization of friable scheelite, which results in abnormal losses in the slimes. The use of flotation for the recovery of scheelite from slimed material has been investigated by the Bureau of Mines.[6] Ultraviolet lamps for detecting scheelite by fluorescence have aided the prospector, miner, and millman engaged in the search for and reduction of tungsten ores carrying it. The use of this equipment has been described by Heizer.[7]

Arizona.—Shipments of tungsten concentrates from Arizona operations totaled only 35 short tons containing 63.09 percent WO_3 in 1938 compared with 312 tons averaging 67.15 percent WO_3 in 1937. Output comprised scheelite, wolframite, huebnerite, and ferberite concentrates and came from scattering small operations in Cochise, Gila, Mohave, Pima, and Yavapai Counties. The mill at the Boriana mine near Yucca, Mohave County, destroyed by fire in November 1937, was rebuilt but not operated in 1938.

California.—Shipments of tungsten concentrates (all scheelite) from California amounted to 770 short tons containing 65.44 percent WO_3 in 1938 compared with 511 tons containing 67.68 percent WO_3

[6] Leaver, E. S. and Royer, M. B., Flotation for Recovery of Scheelite from Slimed Material: Bureau of Mines Tech. Paper 585, 1938, pp. 1–24.
[7] Heizer, Ott F., Use of Ultraviolet Light in Prospecting for Scheelite: California Jour. Mines and Geol., State Mineralogist's Report 34, vol. 34, No. 3, July 1938, pp. 331-333.

in 1937. The largest producer, the Atolia Mining Co. near Atolia in San Bernardino County, shipped 339 tons containing 59.71 percent WO_3. The company milled 13,289 tons of ore containing 1.82 percent WO_3. Sixteen other producers—8 in San Bernardino County, 5 in Inyo, and 1 each in Kern, Mono, and Tulare Counties—contributed to the California total. The increased number of producers—17 in 1938 compared with 8 in 1937—attest to the increased interest in tungsten in California, but as prices dropped later in 1938 a number of operations were closed. Activities in recent years in the region around Bishop have resulted in some significant developments that may serve further to increase domestic output.

Colorado.—Output of tungsten in Colorado was higher in 1938 than in 1937. Total shipments were 360 short tons of concentrates averaging 40.05 percent WO_3. Most of the output was ferberite from Boulder County, but there were small shipments of huebnerite from gold-mining operations in San Juan County. The principal shipments came from the mill of the Gold, Silver & Tungsten, Inc., at Tungsten, Boulder County. The other large producer (the mine of the Wolf Tongue Mining Co. near Nederland) was idle for 9 months but is planning extensive underground development work in 1939. The mill treated 871 short tons of ore containing 2.8 percent WO_3. A 50-ton concentration mill was built at the Conger mine in 1938 by the Vanadium Corporation of America.

Idaho.—The Ima mine on Patterson Creek about 11 miles east of May operated during the last 10 months of 1938. The mill was enlarged to 150 tons capacity; 26,823 short tons of ore containing 0.5 percent WO_3 were milled, yielding 139 short tons of huebnerite concentrates averaging 66.54 percent WO_3. The mill also makes a sulfide concentrate carrying silver, copper, lead, and zinc.

Missouri.—A small shipment (less than 1 ton) of high-grade concentrates was reported from Missouri in 1938. The hand-picked ore came from the dump of the old Silver mine 10 miles west of Fredericktown, Madison County.

Nevada.—Nevada retained its position as the principal tungsten producer in 1938; shipments of concentrates totaled 1,461 short tons reduced to equivalent 60 percent WO_3. A large part of the output was scheelite concentrates from mines of the Nevada-Massachusetts Co. near Mill City and Mina. The company has sunk the Humboldt and Stank shafts to the 1,350 level and is reopening and developing the Sutton ore body. The new mill operating on tailings is working successfully, and a good grade of concentrate (70 percent WO_3) is being produced. The Tungsten Metals Corporation at Ely, White Pine County, produced from three mines and was the largest of several other small operators that contributed to the Nevada total in 1938.

Development work continued, and new equipment was installed at the Oreana mine in Pershing County by the Rare Metals Corporation. The Oreana tungsten deposit is unique among American tungsten deposits in that the scheelite mineralization is considered pegmatitic.[8] An addition to the mill at the Nightingale mine 50 miles west of Lovelock, Pershing County, was installed in 1938.

[8] Kerr, Paul F., Tungsten Mineralization at Oreana, Nev.: Econ. Geol., vol. 33, No. 4, June-July 1938, pp 390–425.

New Mexico.—A small shipment of huebnerite concentrates averaging 53.12 percent WO_3 was made from Luna County in 1938.

Utah.—Shipments from Utah in 1938 totaled only 16 short tons (all scheelite) averaging 25.50 percent WO_3. The bulk of the shipments came from the Star Dust mines near Gold Hill operated by Star Dust Mines, Inc. Less than 1 ton of scheelite concentrates running 71.46 percent WO_3 was shipped from Juab County.

Washington.—Shipments of tungsten concentrates from Washington in 1938 comprised 328 short tons averaging 55.39 percent WO_3. Virtually all the shipments (326 tons) came from the Germania mine near Fruitland in Stevens County and were wolframite concentrates containing 55 percent WO_3. Operations at the Germania mine were curtailed at the close of 1938. The remaining shipments (2 tons) came from another operator in 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) dropped sharply in 1938 and totaled only 162,744 pounds compared with 5,561,022 pounds in 1937. Of the 1938 total, 43 percent came from China and 41 percent from British Malaya. In addition, 828,660 pounds of tungsten in concentrates were imported for smelting, refining, and export compared with 502,571 pounds in 1937. 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, were lower in 1938.

Tungsten ore and concentrates imported for consumption in the United States, 1937–38, by countries

Country	1937			1938		
	Gross weight (pounds)	Tungsten content (pounds)	Value	Gross weight (pounds)	Tungsten content (pounds)	Value
Africa:						
British South, other [1]	53,000	27,740	$12,681			
Union of South Africa	102,603	54,041	25,271	45,069	23,233	$35,985
Argentina	257,797	138,225	71,266			
Australia	566,522	306,770	212,098			
Belgium	95,200	42,197	21,485			
Bolivia	143,763	74,878	29,780	2,286	705	961
British Malaya	1,590,883	975,786	538,995	108,765	67,460	58,346
Chile	18,700	8,677	4,327			
China	7,104,224	3,794,440	1,941,844	138,380	69,986	42,350
Hong Kong	33,600	17,472	14,511			
Japan	111,152	59,560	34,078			
Mexico	89,763	48,734	27,086	27,585	1,360	1,051
Sweden	22,418	12,502	6,616			
	10,189,625	5,561,022	2,940,038	322,085	162,744	138,693

[1] Rhodesia (Northern and Southern), Bechuanaland, and Nyasaland Protectorate.

Tungsten in metal and compounds imported for consumption in the United States, 1937–38, by countries

Country	Tungsten (metal) and tungsten carbide [1]				Tungstic acid and other compounds of tungsten			
	1937		1938		1937		1938	
	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value	Tungsten content (pounds)	Value
Austria	1,600	$6,174	[2] 220	[2] $701				
Canada	1,046	1,044			30	$75		
France							28	$523
Germany	21	170	[2] 1,565	[2] 6,822	492	1,586	169	680
Hungary							44	403
Switzerland	9,819	12,538						
United Kingdom	121,473	111,987	21,029	23,994				
	133,959	131,913	22,814	31,517	522	1,661	241	1,606

[1] Includes combinations containing either metal or carbide.
[2] Austria included with Germany beginning May 6.

USES

The principal uses of tungsten are in the manufacture of high-speed-tool steels, cemented tungsten carbides, stellites, and electric-light and radio-tube filaments; in the preparation of various chemicals, such as pigments; and in the tanning of white leather. In recent years cemented tungsten carbide has been employed widely in the commercial field. Methods of manufacture, as well as properties and uses, have been described by Sykes.[9] A new alloy of tungsten with 4-percent copper and 6-percent nickel is said to be a suitable material for radium containers. A new process [10] for combining tungsten by electrodeposition with other metals is said to be susceptible to close control.

WORLD PRODUCTION

World output of tungsten was lower in 1938 than in 1937, when a new peak was established. Although complete figures are not available, preliminary data indicate that world production in 1938 may have reached 32,000 metric tons.

[9] Sykes, W. P., Cemented Tungsten Carbide Alloys: Metals Technol. Am. Inst. Min. and Met. Eng., vol. 5, No. 4, June 1938, pp. 1–11.
[10] Armstrong, H. H. and Menefee, A. B., Electroplating Method and Product: U. S. Patent 2,145,745 January 31, 1939.

World production of tungsten ores, 1934–38, by countries, in metric tons of concentrates, containing 60 percent WO_3

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
North America:					
Mexico	80	54	57	33	76
United States (shipments)	1,859	2,173	2,370	3,175	2,761
	1,939	2,227	2,427	3,208	2,837
South America:					
Argentina	392	579	702	[2] 1,063	(3)
Bolivia [2]	794	1,423	1,741	1,802	2,530
Chile		7	3	5	(3)
Peru	12	57	92	30	170
	1,198	2,066	2,538	2,900	(3)
Europe:					
Germany (Saxony)	1				(3)
Great Britain (Cornwall)	223	256	221	148	258
Italy				3	(3)
Norway				2	(3)
Portugal	610	1,140	1,414	2,069	2,812
Spain	49	(3)	(3)	(3)	(3)
Sweden			62	127	(3)
	883	[4] 1,396	[4] 1,697	[4] 2,349	(3)
Asia:					
Burma	3,913	4,527	5,382	5,924	3,410
China [2]	5,099	7,998	7,638	17,895	13,387
Chosen	399	949	1,849	2,058	(3)
India, British				15	(3)
Indochina (Tonkin)	300	417	503	648	(3)
Japan	70	96	61	(3)	(3)
Malay States:					
Federated Malay States	1,921	1,720	1,712	955	667
Unfederated Malay States	90	315	325	279	(3)
Netherland India	1	1	1	(5)	(3)
Siam	36	82	82	257	(3)
	11,829	16,105	17,553	[6] 28,031	(3)
Africa:					
Egypt				193	(3)
Nigeria	5	16	11	9	49
Southern Rhodesia	117	26	88	275	329
South-West Africa	18	53	46	41	48
Tanganyika Territory		6	2	2	(3)
Uganda				2	(3)
Union of South Africa		11	30	40	130
	140	112	177	562	(3)
Oceania:					
Australia:					
New South Wales	59	63	18	66	(3)
Northern Territory	89	126	141	345	(3)
Queensland	41	27	22	110	167
Tasmania	230	275	245	345	390
New Zealand	39	61	49	28	57
	458	552	475	894	(3)
	16,447	[4] 22,458	[4] 24,867	[4] [6] 37,944	(3)

[1] In addition to the countries listed, tungsten ore is produced in the U.S.S.R., but no data of production are available for the period under discussion.
[2] Exports.
[3] Data not available.
[4] Exclusive of Spain.
[5] Less than 1 ton.
[6] Exclusive of Japan.

Argentina.—Argentina is the second largest producer of tungsten in South America. Output comes principally from the Provinces of San Luis and Cordoba; much smaller amounts are produced in San Juan and Catamarca. Virtually all the yield is exported, a large part going to Europe.

Bolivia.—Bolivia is the largest producer in South America. The largest deposits occur in the Department of Oruro, while smaller deposits are found in Potosi, La Paz, and Cochabamba. Bolivian tungsten concentrates (wolframite and scheelite) are exported, largely to Europe.

Burma.—Output in Burma comes principally from the Hermingyi mine near Tavoy and the Mawchi mine in the southern part of Karenni State. The ores from the Mawchi mine are said to be complex in character and not easy to treat for their tin and tungsten contents, but the ores from the Hermingyi are much simpler. The ore reserves at the Mawchi mine are said to contain 3.24 percent tin and tungsten. The proportion of tungsten to tin in the Hermingyi ores is about 2 to 1. Most of the concentrates from India are shipped to the United Kingdom. Exports from Burma in 1938 were 10,598 metric tons.

China.—The Sino-Japanese hostilities continued their adverse effect on the flow of tungsten ore from China, the largest world source. The principal production comes from Hunan, Kiangsi, and Kwangtung, where the tungsten-producing areas are not under Japanese control, and the mines still are being worked extensively. Formerly much of the exports moved out of Shanghai, coming from inland through the river ports of Hankow, Hupeh Province; Kiukiang, Kiangsi Province; and Changsha, Hunan Province. With the closing of the Yangtze and Whangpoo Rivers and exhaustion of the stocks on hand in 1937, exports from Shanghai ceased, and Chinese concentrates moved out via the Canton-Hankow Railroad for transshipment at Hongkong. In 1938 Canton fell to the Japanese, and the Chinese Central Government endeavored to route all tungsten ore shipments via South China ports (Swatow, Haiphong, and Macao) not under Japanese control, or through Indochina. Exports in 1938 were 13,387 metric tons (60 percent WO_3 basis) compared with 17,895 tons in 1937. There were no exports during the last 2 months of 1938. A large proportion of the exports in 1938, which went principally to Europe, was shipped under barter agreements.

It was reported early in 1939 that the Chinese Government has granted to the Peiping Syndicate, Ltd., exclusive selling rights for Chinese tungsten ore, including the stocks in Honkong.

India, British.—There is little or no production of tungsten in India. Production 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 is scheelite of good quality, but the reserves are limited. Exports in 1938 amounted to 665 metric tons of concentrates, of which 287 metric tons were scheelite concentrates and the remainder wolframite concentrates. The exportation of tungsten ore containing more than 1.5 percent tin has been prohibited by the High Commissioner of the Federated Malay States, except under written authorization by the Chief Inspector of Mines.

Portugal.—Output in Portugal, the largest European producer, in 1938 increased 36 percent over 1937 and nearly doubled the 1936 figure. The Beralt Tin & Wolfram, Ltd., with properties at Panasqueira in the Province of Beira Baixa, district of Castello Branco, was the largest producer. The ore is low-grade, and it has been stated that 300 tons of rock must be broken to produce 1 ton of concentrates. Exports (2,450 metric tons in 1938) went to European manufacturers of ferrotungsten.

Southern Rhodesia.—The African Continent produces little tungsten; the principal output comes from Southern Rhodesia, where production increased to 329 metric tons in 1938 from 275 tons in 1937.

VANADIUM

Vanadium output in 1938 maintained the high level reached in 1937, although there was a noticeable shift in sources. The world supply comes from a limited number of operations, principally in four countries, of which Peru normally is the most important. Production in that country, all from the Minasragra mine, dropped abruptly in 1938. A striking feature of the year was the large increase in domestic production (shipments from mines), and in 1938 the United States became the largest producer. Greatly increased output in the Paradox Valley region in Colorado swelled the domestic total. Production in Northern Rhodesia was 59 percent above 1937, while output in the Territory of South-West Africa dropped a little. World sources of vanadium may be supplemented further in future by the recovery of vanadium from the treatment of pig iron made from vanadium-bearing iron ores at ferrous smelters in Germany. A plant for the recovery of vanadium was completed in 1938 in Japan by the Japan Iron Sand Industrial Co.

Despite the large increase in domestic production imports for consumption into this country increased. Purely nominal quotations for vanadium ore were unchanged throughout 1938 at 27½ cents per pound of contained V_2O_5.

Salient statistics of the vanadium industry in the United States, 1937–38

	1937		1938	
	Quantity	Value	Quantity	Value
Production:				
Carnotite ores [1] ....short tons..	1,708	$65,294	4,290	$158,779
Vanadium contained........pounds..	73,788	(2)	173,859	(2)
Vanadium and complex ores........short tons..	129,372	(3)	227,397	[4] 740,000
Vanadium contained........pounds..	1,012,337	(3)	1,439,296	(2)
Imports:				
Vanadium ores........short tons..	7,403	638,799	9,981	891,475
Vanadium contained........pounds..	1,258,880	....	1,384,320	....

[1] Also contained radium and uranium as follows: Radium—1937, 3,141 milligrams; 1938, 7,821 milligrams. Uranium—1937, 20,764 pounds; 1938, 51,705 pounds.
[2] Figures not available.
[3] Bureau of Mines not at liberty to publish figures.
[4] Estimated by Bureau of Mines.

DOMESTIC PRODUCTION

Production in the United States of vanadium contained in all types of ores from which it was recovered totaled 1,613,155 pounds in 1938 compared with 1,086,125 pounds in 1937. Output came from Arizona, Colorado, Nevada, and Utah, Colorado supplying the largest quantity.

Arizona.—Vanadium was produced from the 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 a flotation mill operated by the latter company. The mill treated 165,465 short tons of ore, from which 4,191 tons of concentrates containing 238,000 pounds of V_2O_5 were recovered. The geology and ore deposits of the Mammoth mining camp area have been described by Peterson.[11] Development work was continued by the International Vanadium Corporation at the Dripping Springs mine near Globe, but there was no production.

Colorado.—The production of vanadium in Colorado in 1938 amounted to 1,382,736 pounds in vanadium and carnotite ores. The largest output was from operations of the United States Vanadium Corporation in Paradox Valley. The ore runs under 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.

A 20-ton mill was erected near Gateway, Mesa County, by the Gateway Alloys, Inc., to treat ores mined from nearby claims.

Nevada.—Output in 1938—only 7 tons of vanadinite and descloizite concentrates—came from operations at the Spelter mine near Goodsprings, Clark County.

Utah.—Vanadium-bearing ores were produced at a number of rather widely scattered locations in Utah. Shipments totaling 172,194 pounds of contained V_2O_5 originated in Grand and San Juan Counties in the southeastern part of the State. The largest output was made by the Harbro mines near Cisco, Grand County, and consisted of concentrates containing carnotite.

FOREIGN TRADE

Imports of vanadium ores in 1938, all from Peru, amounted to 9,981 short tons containing 1,384,320 pounds of vanadium. Data on exports are not given by the Bureau of Foreign and Domestic Commerce, but in 1938 several hundred short tons of vanadium-bearing ore or concentrates were exported to Japan.

USES

The principal use of vanadium is in the manufacture of special alloy steels and irons. Minor quantities are 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. Vanadium produces high-strength steel and iron with much less exacting heat treatment than is necessary with other alloys, at a lower cost for both heat treating and machinery.[12]

WORLD PRODUCTION

Despite the sharply reduced yield in Peru, one of the principal sources, world output in 1938 exceeded that in 1937, owing principally to the large increase in production in the United States. Output in

[11] Peterson, N. P., Work cited in footnote 2.
[12] Priestley, W. J., Vanadium in Steel and Iron: Metals and Alloys, vol. 9, Nos. 8 and 9, August and September 1938, pp. 193–197, 237–241.

Peru comes from the Minasragra mine of the Vanadium Corporation of America. Exports from Peru comprised 7,453 metric tons of ore and 2,886 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 mine of the Otavi Minen and Eisenbahn Gesellschaft—contributed to the total in the Territory of South-West 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.

World production of vanadium in ores and concentrates, 1934–38, in metric tons

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Mexico				45	180
Northern Rhodesia	3	173	204	235	374
Peru	[1] 75	67	161	583	102
South-West Africa	34	176	547	591	557
United States	(2)	(2)	63	493	732

[1] Shipments from stock.
[2] Bureau of Mines not at liberty to publish figures.

BAUXITE AND ALUMINUM

By Herbert A. Franke and M. E. Trought[1]

SUMMARY OUTLINE

As a result of the recession in industrial activity, production and consumption of aluminum in the United States in 1938 fell below the records established in 1937. Primary aluminum production declined 2 percent and consumption 47 percent. Quoted prices of aluminum remained unchanged throughout the year. The United States Department of Justice continued its suit against the Aluminum Co. of America, charging violation of the antitrust laws. Under the Canadian Trade Agreement the United States import duty on aluminum was reduced from 4 to 3 cents per pound. At the close of the year the outlook was improved by the upturn in business during the last quarter.

The domestic bauxite industry likewise experienced a downward trend in 1938, as indicated by decreases in production, consumption, and foreign trade. Although total bauxite consumption was only 6 percent lower, domestic production fell 26 percent, largely as a result of the increased use of foreign ore. Imports and exports of bauxite declined 10 and 53 percent, respectively, but net imports advanced 23 percent. The proportion of domestic needs supplied by domestic mines thus dropped from 60 percent in 1937 to 47 percent in 1938. Quoted prices for bauxite in 1938 differed little from those in 1937.

Salient statistics of the bauxite and aluminum industries in the United States, 1929 and 1937–38

	1929	1937	1938
Bauxite:			
Production ... long tons	365,777	[1] 439,000	[1] 323,818
Value	$2,265,638	$2,444,686	$1,812,545
Imports ... long tons	380,812	507,423	455,693
Exports (including concentrates) ... do	133,551	123,191	57,726
World production ... do	2,115,000	3,621,000	[2] 3,789,000
Aluminum:			
Primary production ... short tons	113,987	146,341	143,441
Value	$51,864,000	$55,609,000	$56,659,000
Quoted price per pound [3] ... cents	23.9	20.1	20.0
Secondary production ... short tons	48,400	62,560	38,800
Imports	$10,860,009	$8,177,600	$3,379,018
Exports	$7,971,085	$2,943,214	$5,484,047
World production ... short tons	312,300	530,800	[2] 619,300

[1] Dried bauxite equivalent; figure not strictly comparable with 1929.
[2] Estimated.
[3] New York: 1929, virgin metal 98–99 percent pure; 1937–38, 99 percent plus, pure virgin ingot, according to Metal Statistics 1939, published by American Metal Market.

[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.

Although official data on world output of bauxite and aluminum in 1938 are incomplete, both commodities probably established new high records. For the third time in the last 5 years the production of aluminum in Germany exceeded that in the United States. Of the total output of the world, Germany contributed 29 percent and the United States 23 percent. Canada, U. S. S. R., and France ranked next in importance as producers. The total consumption of more than 500,000 short tons of aluminum in 1938 can be attributed partly to the strategic importance of the metal in a war-threatened world. Totalitarian countries have found aluminum an expedient substitute for many deficient metals. In addition technologic research has developed many new industrial uses.

Although world output of aluminum in 1938 increased about 17 percent over 1937, bauxite production advanced only 5 percent. France, the leading bauxite-producing country, maintained the high output level of 1937, and British Guiana, Hungary, the U. S. S. R., and Yugoslavia achieved a substantial increase in production. The United States ranked seventh in importance and produced only 8 percent of the total.

BAUXITE

PRODUCTION

Domestic production of bauxite in 1938 was 26 percent less in quantity and value compared with 1937. The entire decline can be attributed to decreased production at mines in Arkansas and Georgia as shipments from Alabama increased. The underground and open-pit mines in Saline and Pulaski Counties, Ark., produced 95 percent of the total domestic output. The remaining 5 percent was contributed by mines in Barbour and Henry Counties, Ala., and in Sumter County, Ga.

Heretofore reported shipments of bauxite have included crude, dried, and calcined ore but have not considered the difference in the moisture content of the various products which may vary widely according to locality and the amount of processing involved. These statistics did not provide a suitable basis for comparing output by years, localities, or consuming industries. To place all tonnages on a comparable basis, shipments now have been converted to a theoretical dried bauxite equivalent, which not only presents a more accurate picture of the details of the domestic industry but also affords a more equitable comparison of the domestic output with imports and foreign production.

The actual shipments shown in the table represent the condition in which the ore was shipped by the mining companies to consumers. Some consumers maintain processing plants near the mines and in consequence ship the products to their final consuming plants in more concentrated form than they are purchased from the mines. Very little crude ore is shipped any great distance. Net shipments from mining areas in 1938, including material moving both from producers' plants and consumers' processing plants, comprised 207,132 tons of dried bauxite, 50,939 tons of calcined, and only 9,408 tons of crude. Shipments of activated bauxite, although only partly calcined, are included with those of calcined ore.

The following table shows both the condition of bauxite as shipped and the estimated dried bauxite equivalent of these shipments, by States.

Bauxite shipped by producers in the United States, 1934–38, by States

State and year	Long tons					Value, f. o. b. mine
	Crude	Dried	Calcined	Total		
				As shipped	Dried bauxite equivalent	
Alabama and Georgia:						
1934	187	11,887		12,074	12,050	$71,991
1935	100	14,021		14,121	14,108	91,293
1936	91	16,971		17,062	17,050	109,327
1937	3,410	14,627		18,037	17,491	121,825
1938	5,532	[1] 12,542		18,074	17,250	132,882
Arkansas:						
1934	3,002	121,057	21,705	145,764	157,312	1,057,062
1935	21,594	164,349	33,848	219,791	233,263	1,465,302
1936	49,243	268,900	36,800	354,943	365,751	2,089,196
1937	98,340	257,023	46,832	402,195	421,509	2,322,861
1938	72,097	194,945	[1] 26,238	293,280	306,568	1,679,663
Total United States:						
1934	3,189	132,944	21,705	157,838	169,362	1,129,053
1935	21,694	178,370	33,848	233,912	247,371	1,556,595
1936	49,334	285,871	36,800	372,005	382,801	2,198,523
1937	101,750	271,650	46,832	420,232	439,000	2,444,686
1938	77,629	[1] 207,487	[1] 26,238	311,354	323,818	1,812,545

[1] Includes small quantity of activated bauxite.

Bauxite producers in the United States in 1938

AMERICAN CYANAMID & CHEMICAL CORPORATION, 30 Rockefeller Plaza, New York, N. Y.—Ozark underground mine, Saline County, and Rauch underground mine, Pulaski County, Ark.; Hatton underground mine, Sumter County, Ga.

ARKANSAS BAUXITE CORPORATION, Bauxite, Ark. (mining by West Bauxite Mining Co.).—Standard and McDonald underground mines and Bizzell open-pit mine, Saline County, Ark.

CONSOLIDATED CHEMICAL INDUSTRIES, INC., 811 Petroleum Building, Houston, Tex.—Alexander underground mine, Saline County, Ark.

CROUCH MINING CO., INC. (General Abrasive Co.), P. O. Box 35, Bridge Station, Niagara Falls, N. Y.—England underground mine, Pulaski County, Ark.

DIXIE BAUXITE CO., INC., Sweet Home, Ark.—Dixie No. 2 underground mine, Pulaski County, Ark.

BENJAMIN EASTERLIN, Americus, Ga.—Easterlin open-pit mine, Sumter County, Ga.

FLORIDIN CO., 220 Liberty Street, Warren, Pa.—Scott open-pit mine, Henry County, Ala.

PULASKI BAUXITE CO., 301 Southern Building, Little Rock, Ark.—Pulaski open-pit mine, Pulaski County, Ark.

REPUBLIC MINING & MANUFACTURING CO., 230 Park Avenue, New York, N. Y.—Lantz, Bertha, Maud Nos. 2 and 3, Sections 14, 23, and 26 open-pit mines, Saline County, Ark.; Ratcliffe open-pit and underground mine, Pulaski County, Ark.; Neilson, Davis, and Crosscut No. 23 underground mines, Saline County, Ark.; Eufaula open-pit mines (chiefly Baker and Clarke), Barbour and Henry Counties, Ala.

Most of these producers operate beneficiating and drying or calcining plants near their mines. Other companies that purchase bauxite but operate processing plants in the mining area are: Aluminum Ore Co., East St. Louis, Ill.—at Sweet Home, Ark.; Max B. Miller & Co., Inc., 501 Fifth Avenue, New York, N. Y.—at West Bauxite, Ark.; Norton Co., Worcester, Mass.—at Bauxite, Ark.; and Porocel Corporation, 260 South Broad Street, Philadelphia, Pa.—plant under construction at Berger, Ark.

There were only two new bauxite-producing concerns in 1938—the Consolidated Chemical Industries, Inc., and the Floridin Co. The latter has acquired bauxite deposits in Henry and Barbour Counties, Ala., as well as the drying plant of Charles Lennig & Co. at Eufaula, Ala. The crude bauxite produced by the company in Henry County in 1938 was shipped to Quincy, Fla., to be activated. The Crouch Mining Co., Inc., plans to complete sinking a shaft on its Young bauxite property, Saline County, in 1939. Both Charles Lennig & Co. and J. M. Mathison, producers of bauxite in southeastern Alabama in 1937, reported no shipments in 1938. Of significance recently in the industry was the installation of magnetic separation, screening, and other processing equipment in the Arkansas mining area (see Minerals Yearbook 1938, p. 579), chiefly to serve demands of the chemical and oil-refining industries. Max B. Miller & Co., Inc., produced activated bauxite at its new plant near that of the Arkansas Bauxite Corporation, and the Porocel Corporation began erection of a processing plant near that of the American Cyanamid & Chemical Corporation, which controls the new concern jointly with the Attapulgus Clay Co.

Aluminum is classed as one of the strategic materials by the Army and Navy Munitions Board, chiefly because of the limited quantities of commercial-grade bauxite available in the United States. Owing to recent interest in national defense it seems appropriate at this time to present a table containing data on bauxite production and consumption since 1910.

Production, imports, exports, and apparent consumption of bauxite in the United States, 1910–38, in long tons

Year	Domestic production					Imports	Exports	Apparent consumption
	Arkansas	Alabama	Georgia	Tennessee	Total			
1910	110,406	9,517	23,579	5,430	148,932	15,669	([1])	164,601
1911	122,183	8,848	21,322	3,265	155,618	43,222	([1])	198,840
1912	117,299	14,173	19,587	8,806	159,865	26,214	([1])	186,079
1913	169,871	9,192	18,217	12,961	210,241	21,456	([1])	231,697
1914	195,247	7,829	10,718	5,524	219,318	24,844	[1] 5,374	238,788
1915	268,796	10,290	14,718	3,237	297,041	3,420	16,082	284,379
1916	375,910	5,763	40,388	3,039	425,100	30	17,939	407,191
1917	506,556	8,281	52,901	952	568,690	7,691	21,791	554,590
1918	562,892	4,928	35,637	2,264	605,721	3,653	19,711	589,663
1919	333,490	3,700	37,201	2,175	376,566	6,082	17,701	364,947
1920	481,279	4,044	34,397	1,588	521,308	42,895	22,257	541,946
1921	124,850	4,200	10,200	300	139,550	27,587	5,942	161,195
1922	266,790	10,430	30,420	1,960	309,600	23,656	19,617	313,639
1923	493,880	245	22,553	6,012	522,690	119,020	78,560	563,150
1924	327,630		16,140	3,800	347,570	201,974	77,065	472,479
1925	296,320		18,220	2,000	316,540	353,696	78,633	591,603
1926	371,570		19,680	1,000	392,250	281,644	87,770	586,124
1927	303,830	4,060	13,050		320,940	356,580	121,858	555,662
1928	361,236	6,748	6,982	460	375,426	350,111	112,984	612,553
1929	351,054	[2] 14,723	([2])		365,777	380,812	133,551	613,038
1930	315,273	[2] 15,339	([2])		330,612	409,678	104,504	635,786
1931	186,697	[2] 9,198	([2])		195,895	306,490	88,370	414,015
1932	89,779	[2] 6,570	([2])		96,349	205,620	28,474	273,495
1933	142,179	[2] 11,997	([2])		154,176	149,548	21,760	281,964
1934 [3]	157,312	[2] 12,050	([2])		169,362	166,653	84,834	251,181
1935 [3]	233,263	[2] 14,108	([2])		247,371	199,959	141,060	306,270
1936 [3]	365,751	[2] 17,050	([2])		382,801	322,790	144,445	561,146
1937 [3]	421,509	[2] 17,491	([2])		439,000	507,423	210,657	735,766
1938 [3]	306,568	[2] 17,250	([2])		323,818	455,693	90,341	689,170

[1] Not separately classified prior to July 1914.
[2] Georgia included with Alabama.
[3] Dried bauxite equivalent; figures not strictly comparable with earlier years.

CONSUMPTION BY INDUSTRIES

Virtually all the bauxite produced in and imported into the United States is consumed by the aluminum, chemical, abrasive, oil-refining, and refractory industries. A list of the principal domestic bauxite consumers appears on pages 669 and 670 of Minerals Yearbook 1937.

The following table shows producers' shipments of bauxite to consumers in the condition shipped—that is, crude, dried, activated, and calcined ore—and the dried bauxite equivalent of these products. Unless otherwise noted all mention of domestic production and consumption in the discussion that follows is in terms of dried bauxite.

Bauxite shipped by producers in the United States, 1934–38, by consuming industries, in long tons

Industry	1934		1935		1936		1937		1938	
	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent	As shipped [1]	Dried bauxite equivalent
Aluminum	55,630	55,630	112,154	112,154	211,990	211,990	211,275	209,476	146,687	146,365
Chemical	67,153	66,765	66,316	66,303	73,972	73,960	75,561	75,321	61,461	61,231
Abrasive [2]	34,580	46,492	53,684	66,381	84,363	94,454	126,339	146,285	92,874	105,702
Oil refining							3,602	3,095	8,536	8,298
Refractory and other [2]	475	475	1,758	2,533	1,680	2,397	3,455	4,823	1,796	2,222
	157,838	169,362	233,912	247,371	372,005	382,801	420,232	439,000	311,354	323,818

[1] Crude, dried, activated, and calcined.
[2] Small quantity of bauxite shipped to makers of refractories probably included under "abrasive."

The supply of bauxite (dried-bauxite basis)—that is, domestic production plus net imports—totaled 689,170 tons in 1938 compared with 735,766 tons in 1937. Net imports accounted for 53 percent of the total in 1938 compared with 40 percent in 1937.

Aluminum.—All domestic ore used in aluminum manufacture comes from Arkansas. Shipments in 1938 represented 45 percent of the total bauxite output of the United States. Consumption was 30 percent less than in 1937, owing principally to the increased proportion of imported ore used. More than two-thirds of the industry's bauxite requirements came from South America, chiefly Surinam. All bauxite used by the industry was refined at East St. Louis, Ill., and at the new Bayer-process plant, Mobile, Ala.

Abrasive.—The abrasive industry consumed 28 percent less bauxite in 1938 than in 1937. It remained the second largest consumer of domestic ore and took 33 percent of the total bauxite shipped by producers. Calcined bauxite containing 78 to 84 percent Al_2O_3 and refined alumina are used in the manufacture of artificial corundum, emery, and other abrasives.

Chemical.—Domestic shipments of bauxite to the chemical industry decreased 15 percent in 1938 and represented 20 percent of the total ore shipments. Of the total bauxite consumed by this industry domestic ore comprised 52 percent and imported ore, chiefly from British Guiana, 48 percent. Producers of aluminum salts reported the use of bauxite equivalent to 173,000 long tons of dried bauxite in 1938, only 1 percent less than in 1937. These manufacturers also used 4,068 short tons of alumina, 610 tons of aluminum metal, and a small quantity of clay and alunite. Domestic shipments of aluminum salts in 1938 dropped 12 percent.

Aluminum salts and alumina produced in the United States, 1937–38

	1937		1938	
	Producers	Short tons	Producers	Short tons
Aluminum salts:				
Alum:				
Ammonia	6	5,440	7	3,754
Potash	4	3,098	3	1,715
Aluminum chloride:				
Liquid	6	2,245	6	2,167
Crystal	2	7,026	2	6,240
Anhydrous	4		4	
Aluminum sulfate:				
Commercial:				
General	14	397,733	16	353,044
Municipal	10	14,125	10	10,278
Iron-free	7	15,103	8	15,082
Sodium-aluminum sulfate	2	24,513	2	24,961
Sodium aluminate	7		7	
Total aluminum salts		469,283		417,241
Alumina [1]	7	24,904	7	29,043

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D produced for sale.

Aluminum salts and alumina shipped by producers in the United States, 1937–38

	1937				1938			
	Shippers	Short tons	Value		Shippers	Short tons	Value	
			Total	Average			Total	Average
Aluminum salts:								
Alum:								
Ammonia	6	5,016	$262,245	$52	7	4,079	$218,019	$53
Potash	3	2,713	152,895	56	3	2,085	121,174	58
Aluminum chloride:								
Liquid	5	2,201	96,910	44	6	2,174	99,208	46
Crystal	2	6,823	645,437	95	2	6,166	521,492	85
Anyhydrous	4				4			
Aluminum sulfate:								
Commercial:								
General	14	394,507	8,793,753	22	16	349,051	7,345,471	21
Municipal	10	14,034	213,841	15	10	10,689	161,160	15
Iron-free	7	16,027	541,563	34	8	14,508	417,446	29
Sodium-aluminum sulfate	2	25,573	1,386,348	54	2	24,153	1,313,384	54
Sodium aluminate	7				7			
Total aluminum salts		466,894	12,092,992			412,905	10,197,354	
Alumina [1]	7	24,813	1,800,412	73	7	29,175	1,955,383	67

[1] Excludes alumina produced for use in making aluminum; includes activated, calcined, crude, hydrate, and monohydrate D.

Aluminum salts shipped in, imported into, and exported from the United States, 1934–38

Year	Domestic shipments		Imports		Exports (aluminum sulfate) [1]	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	368,682	$9,305,651	644	$31,052	30,881	$594,440
1935	402,717	10,082,936	1,424	68,636	33,091	685,347
1936	444,660	10,965,660	2,106	50,608	28,788	578,001
1937	466,894	12,092,992	2,864	61,665	31,807	679,214
1938	412,905	10,197,354	1,871	40,189	27,715	578,330

[1] Also "other aluminum compounds" as follows: 1934, 488 short tons valued at $93,440; 1935, 691 tons, $126,435; 1936, 1,483 tons, $250,262; 1937, 2,609 tons, $426,363; 1938, 1,770 tons, $257,545.

New plants producing aluminum sulfate in 1938 were those of the Natural Products Refining Co., at Jersey City, N. J., and the Kimberly-Clark Corporation, at Niagara, Wis. The American Cyanamid & Chemical Corporation started construction of new aluminum sulfate plants at Mobile, Ala., and Georgetown, S. C.

Oil refining, refractory, and other.—Although activated bauxite began partly to replace natural fuller's earth in decolorizing lubricating oils by percolation methods only in 1937, it already is used widely in Pennsylvania and the Mid-Continent field. Owing largely to the property of indefinite revivification, activated bauxite granules costing $30 to $40 a short ton f. o. b. Arkansas can compete with the lower-cost, shorter-lived fuller's earth ($22 a ton).

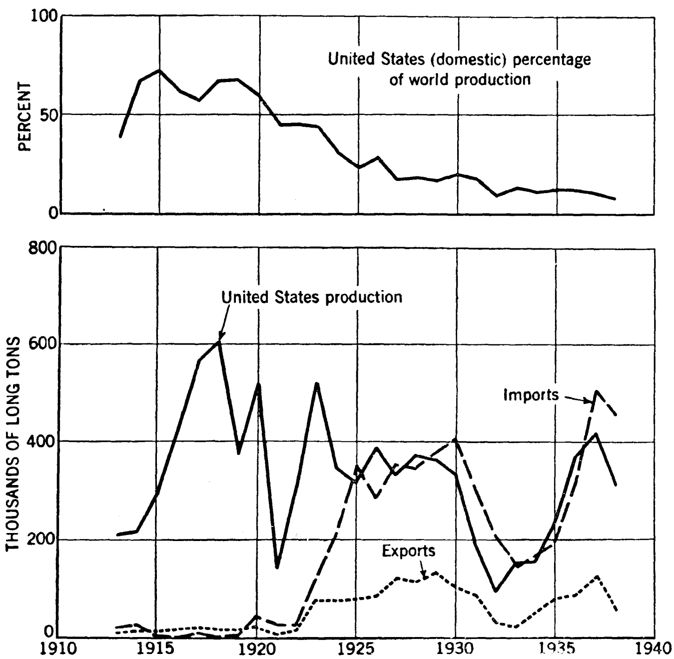

FIGURE 1.—Trends in production, imports, and exports of bauxite, 1913–38.

The refractory industry consumed only about 1 percent of the domestic output of bauxite in 1938, and all the domestic calcium aluminate cement was made from imported bauxite obtained largely from Greece.

PRICES

In 1938 producers of bauxite in the United States reported selling prices ranging from about $2 per long ton for crude, f. o. b. mines, to $40 for activated ore. The weighted average selling price for crushed dried bauxite, f. o. b. mines, was $5.25 per ton and for calcined bauxite, f. o. b. Arkansas mines, $12.38 per ton. The average value for all grades of domestic ores as sold was $5.82 per ton.

FOREIGN TRADE

Bauxite imports in 1938 declined 10 percent compared with 1937, the largest import year on record, and exports (dry equivalent) 57 percent. Of the 1938 imports (chiefly dried ore), Surinam furnished 386,756 long tons, British Guiana 60,044, Greece 8,400, and Netherland India 493. Imports by customs districts were as follows: 279,260 tons to New Orleans, 128,661 to Mobile, 32,929 to Philadelphia, 8,400 to Chicago, and 6,443 to Massachusetts. No bauxite was imported from France in 1938, and apparently the small shipment from Netherland India was for trial purposes only. In addition to bauxite, 64 tons of alumina were imported, almost all from Canada.

Bauxite imported into and exported from the United States, 1934–38

Year	Imports for consumption		Exports (including bauxite concentrates)		Year	Imports for consumption		Exports (including bauxite concentrates)	
	Long tons	Value	Long tons	Value		Long tons	Value	Long tons	Value
1934	166, 653	$1, 201, 710	51, 415	$1, 039, 955	1937	507, 423	$3, 609, 063	123, 191	$3, 456, 916
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					

All exports in 1938 classified as bauxite and other aluminum ores, 43,759 long tons (chiefly calcined ore for use in abrasives), went to Canada. Exports of bauxite concentrates and alumina totaled 13,967 tons and were consigned as follows: Norway, 8,966 tons; Canada, 3,926; Sweden, 1,073; China and Denmark, 1 each; and less than a ton each to Brazil and France.

ALUMINUM

PRODUCTION

Primary.—Domestic production of primary aluminum in 1938 decreased 2 percent in quantity but increased 2 percent in value compared with 1937. The value of aluminum as reported by domestic producers averaged 19.75 cents per pound in 1938 compared with 19 cents in 1937. Of the new aluminum produced in 1938, 40 percent was made at Alcoa, Tenn.; 34 percent at Massena, N. Y.; 14 percent at Badin, N. C.; and 12 percent at Niagara Falls, N. Y.

Aluminum produced in the United States, 1934–38

Year	Primary metal		Secondary metal		Year	Primary metal		Secondary metal	
	Pounds	Value	Pounds	Value [1]		Pounds	Value	Pounds	Value [1]
1934	74, 177, 000	$14, 094, 000	92, 800, 000	$17, 632, 000	1937	292, 681, 000	$55, 609, 000	125, 120, 000	$23, 773, 000
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					

[1] Based on average price of primary aluminum as reported to Bureau of Mines.

A large part of the expansion program started by the Aluminum Co. of America in 1937 was completed in 1938. On July 26, 1938, the 250-ton-capacity (daily) plant at Mobile, Ala., began producing alumina from South American bauxite by the Bayer process. Ten 5,500-kilowatt, double-tank, grid-control, mercury-arc rectifier units were installed at the Alcoa reduction plant and five at Massena. A new sand foundry and forging plant was completed near Los Angeles, Calif., to serve increasing demands for fabricated aluminum alloys by the aircraft industry on the Pacific coast. Other completed developments included a new extrusion mill at Lafayette, Ind., and expansion of the rolling mill at Edgewater, N. J.

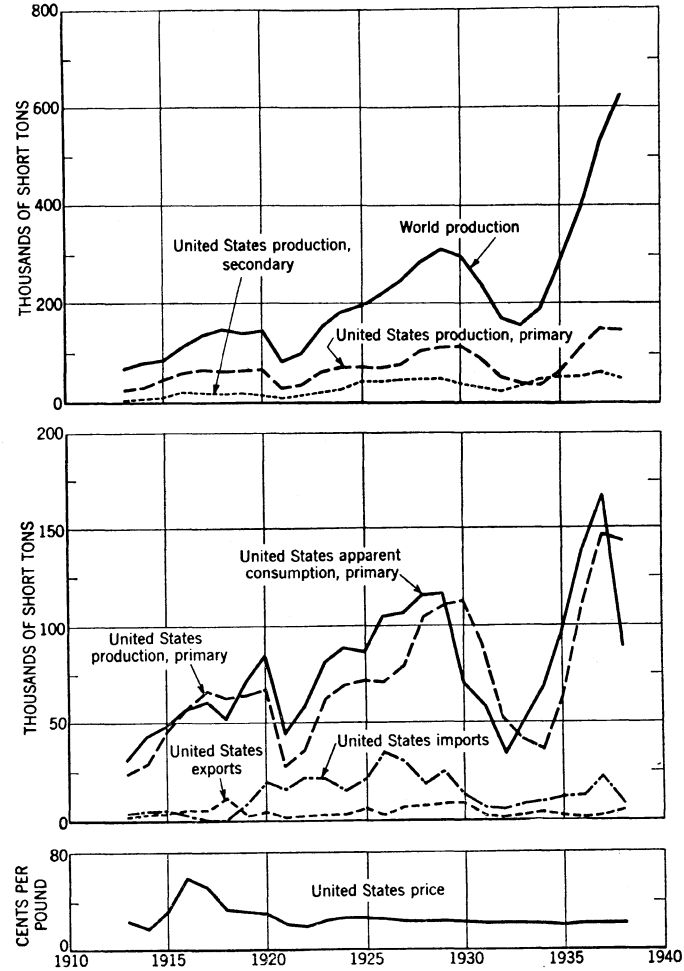

FIGURE 2.—Trends in production, imports and exports, apparent consumption, and average quoted prices of aluminum, 1913–38. Price is for No. 1 virgin 98–99 percent at New York through 1929, thereafter for 99 percent plus virgin ingot, as reported by American Metal Market.

The suit against the Aluminum Co. of America et al., by the United States of America through the Department of Justice, opened on June 30, 1938, in the District Court of the United States for the Southern District of New York. The trial was recessed by Federal Judge Francis G. Caffey on June 30, 1938, until October 13, 1938. By the end of 1938 the Government was still presenting testimony in support of its petition, which asks for dissolution of the company, charging that it is a monopoly in violation of the antitrust laws.

Secondary.—Output of secondary aluminum declined 38 percent in 1938 compared with 1937, according to J. P. Dunlop, of the Bureau of Mines. The metal recovered unalloyed totaled 16,700 short tons and that in alloys (mainly No. 12), 22,100 tons. Most of the scrap metal collected is consumed as soon as it is remelted. To keep pace with the complexity of aluminum-alloy scrap, secondary refiners maintain laboratories to obtain chemical analyses and to check the specifications of the refined or finished alloys.[2] Production of secondary aluminum was equivalent to 27 percent of the primary output in 1938. Additional details on production of secondary aluminum in 1938 are given in the chapter on Secondary Metals in this volume.

Historical record.—Inasmuch as the military and civilian requirements for aluminum have increased greatly, particularly for use in aircraft and heavy transportation, the metal is listed by the Army and Navy Munitions Board as a strategic material. In view of the importance of aluminum for these purposes, a table comprising data on production and consumption since 1910 is presented in this review. Data on the production of aluminum since 1893 are shown in a succeeding table.

Production, imports, exports, and apparent consumption of primary aluminum and production of secondary aluminum in the United States, 1910–38, in pounds

Year	Primary aluminum				Secondary production
	Production [1]	Imports [2]	Exports [2]	Apparent consumption [3]	
1910	35,402,000	(4)	(5)	35,402,000	(4)
1911	38,396,000	4,173,308	(5)	42,569,308	(4)
1912	41,806,000	22,741,271	(5)	64,547,271	(4)
1913	47,279,000	25,095,441	(5)	72,374,441	9,308,000
1914	57,973,000	17,942,958	(5)	75,915,958	9,044,000
1915	90,504,000	9,293,574	(5)	99,797,574	17,000,000
1916	115,107,000	6,698,615	(5)	121,805,615	38,600,000
1917	129,861,000	89,291	[5] 10,020,404	119,929,887	32,200,000
1918	124,725,000	1,690,683	24,135,234	102,280,449	30,100,000
1919	128,477,000	13,852,065	5,020,352	137,308,713	37,382,000
1920	138,042,000	39,298,649	9,407,631	167,933,018	31,000,000
1921	54,532,000	32,559,017	2,196,378	84,894,639	17,800,000
1922	73,633,000	43,891,933	4,347,020	113,177,913	32,580,000
1923	128,658,000	42,476,789	5,539,671	165,595,118	42,600,000
1924	150,564,000	31,809,941	6,343,512	176,030,429	54,000,000
1925	140,116,000	41,997,178	12,642,034	169,471,144	88,000,000
1926	147,386,000	71,391,717	7,634,171	211,143,546	88,400,000
1927	163,607,000	62,575,222	14,522,560	211,659,662	92,400,000
1928	210,544,000	38,847,007	15,728,281	233,662,726	95,600,000
1929	227,973,000	50,880,823	17,032,117	232,747,506	96,800,000
1930	229,037,000	25,461,179	17,329,511	141,864,968	77,200,000
1931	177,545,000	14,832,807	4,700,878	116,993,929	60,600,000
1932	104,888,000	8,184,713	4,436,690	69,688,023	48,000,000
1933	85,125,000	15,246,696	5,707,661	102,537,835	67,000,000
1934	74,177,000	18,591,591	8,365,557	136,561,294	92,800,000
1935	119,295,000	21,291,235	3,970,347	191,645,888	102,800,000
1936	224,929,000	25,562,571	1,605,753	275,443,818	103,000,000
1937	292,681,000	45,178,069	5,383,516	335,958,553	125,120,000
1938	286,882,000	17,740,281	12,618,078	179,045,203	77,600,000

[1] Revised figures 1910–31; value unchanged from figures previously published. Revised figures from 1893 to 1909 are given in the following table.

[2] Crude and semicrude, some of which may be secondary aluminum. Imports are not separately recorded prior to July 1911, and imports from July 1911 through 1912 are general imports (adjusted with stocks in warehouses in 1912); 1913–38 are imports for consumption.

[3] Data not available on fluctuations in consumers' stocks, 1910–38, and in producers' stocks, 1910–28. Withdrawals from producers' stocks totaled 7,873,800 pounds in 1933, 52,158,260 in 1934, 55,030,000 in 1935, 26,558,000 in 1936, and 3,483,000 in 1937; additions to producers' stocks totaled 29,074,200 pounds in 1929, 95,303,700 in 1930, 70,683,000 in 1931, 38,948,000 in 1932, and 112,959,000 in 1938.

[4] Data not available.

[5] Not separately recorded prior to July 1917.

[2] Hollowell, R. D. T., Secondary Aluminum and Its Alloys: Am. Met. Market, vol. 46, No. 32, Feb. 17, 1939, p. 5.

Production of primary aluminum in the United States, 1893–1909

Year ending Aug 31—	Pounds	Year ending Aug. 31—Con.	Pounds
1893	216, 000	1903	6, 636, 000
1894	494, 000	1904	8, 100, 000
1895	501, 000	1905	10, 810, 000
1896	1, 002, 000	1906	14, 125, 000
1897	2, 371, 000	Sept. 1–Dec. 31, 1906	5, 469, 000
1898	2, 993, 000	Year ending Dec. 31—	
1899	3, 262, 000	1907 [1]	16, 325, 000
1900	5, 062, 000	1908 [1]	10, 679, 000
1901	5, 738, 000	1909 [1]	29, 081, 000
1902	5, 763, 000		

[1] Revised figures; value unchanged from figures previously published.

CONSUMPTION

In 1938 the apparent domestic consumption of primary aluminum decreased 47 percent and recovery of secondary aluminum 38 percent compared with 1937. From 1934 to 1938 production of secondary aluminum was equivalent to 45 percent of the apparent consumption of primary metal.

The recession in industrial activity in 1938 caused the lowest consumption of aluminum in any year since 1934, but the marked upturn in business during the closing months of 1938 indicates increased consumption in 1939. The aircraft industry, one of the large users of aluminum, enjoyed a high rate of activity during 1938 and anticipates the greatest year in its history in 1939. Aluminum alloys, because of their strength, durability, and lightness, long have played a large part in the construction of airplane engines and bodies. Manufacturing facilities of American airplane firms were being expanded rapidly late in 1938 to meet the increased demands for aircraft from the United States Government, foreign countries, and commercial air lines. Other types of transportation, such as the automobile, bus,[3] railroad,[4] street-car, and ship [5] industries used large quantities of the metal in 1938 and may consume an even greater tonnage in 1939.

In the mining industry aluminum was used in 1938 for mine skips and cages and for portable tools, such as drills, car loaders, mine cars, hand shovels, power-shovel dippers, and dragline booms.[6] Aluminum is used for chemical equipment because it resists corrosion and has little or no effect on the color of materials processed in it.[7] Aluminum paint is used widely on weather-exposed and interior steel surfaces and on steel products.[8] Since the founding of the industry in 1888 the uses of aluminum have expanded extensively.

PRICES

The price for 99-percent-plus pure virgin ingot aluminum, delivered, based on open-market quotations in New York, remained unchanged at 20 cents per pound, carload lots, throughout 1938. Quotations

[3] James, D. R., Aluminum Saves 1,680 Lb. in White Bus Body: Iron Age, vol. 142, No. 6, Aug. 11, 1938, pp. 28–31.

[4] Woollen, A. H., Aluminum Alloys in the Railroad Industry: Metals and Alloys, vol. 10, No. 1, January 1939, pp. 1–7.

[5] Hughes, W. R. N., Aluminum and Its Alloys with Particular Reference to Their Use in Warships: Paper presented before the Inst. Naval Architects, London, Apr. 8, 1938.

[6] Chesley, J. O., New and Growing Uses for Aluminum: Min. and Met., vol. 19, No. 382, October 1938, pp. 431–435.

[7] Fahrney, H. J., Aluminum Equipment: Chem. and Met. Eng., vol. 45, No. 11, November 1938, pp. 594–596.

[8] Fitch, G. H., Aluminum Paint: Steel, vol. 103, No. 17, Oct. 24, 1938, pp. 64–66, 75.

for smaller lots down to 1 ton demanded a ½-cent premium and for less-than-ton lots a 1-cent premium. In London the domestic quotation for aluminum ingot was reduced on July 21, 1938, from £100 per long ton, less 2 percent delivered, to £94, net cash in 30 days, and the export price was cut from £100 to £90 per metric ton. However, on March 23, 1939, the export price was advanced to £95 per metric ton. European prices for aluminum ingot on December 31, 1938, were (converted in American money): 19.5 cents per pound in the United Kingdom, 24.2 cents in Germany, and 16 cents in France.[9] According to Metal Statistics 1939, dealers' 1938 buying prices per pound in New York for principal grades of domestic aluminum scrap averaged 7.58 cents for cast aluminum and 13.18 cents for new aluminum clips. The average selling price of remelted metal, 98½- to 99-percent grade, was 18.40 cents and of No. 12 alloy, No. 2 grade, 14.91 cents.

FOREIGN TRADE

Imports of crude and semicrude aluminum were 61 percent less in 1938 than in 1937 and exports 134 percent higher. Crude and semicrude metal imports accounted for 10 percent of the apparent consumption of primary aluminum in 1938. Of these imports (8,870 short tons), 2,888 tons came from Norway, 2,647 from France, 1,424 from Switzerland, 1,216 from Canada, and 432 from the United Kingdom. The value of imports of aluminum manufactures decreased 31 percent and that of exports 7 percent. Of the crude and semicrude metal exported in 1938 (6,309 short tons), 2,221 tons went to Germany, 1,118 to the United Kingdom, 1,000 to Switzerland, 927 to Japan, 565 to the U. S. S. R., and 274 to Canada.

Aluminum imported for consumption in the United States, 1936–38, by classes

Class	1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Crude form, scrap, alloy, etc	25,158,541	$4,072,634	44,701,669	$6,770,400	17,511,819	$2,430,828
Plates, sheets, bars, rods, circles, squares, etc	404,030	92,327	476,400	112,139	228,462	60,566
	25,562,571	4,164,961	45,178,069	6,882,539	17,740,281	2,491,394
Manufactures:						
Leaf (5½ by 5½ inches)	(1)	95,798	(1)	67,979	(1)	17,361
Powder in leaf (5½ by 5½ inches)	(2)	976	(2)	212		
Bronze powder and powdered foil	478,043	173,780	295,299	124,276	186,418	77,425
Foil less than 0.006 inch thick	1,879,389	655,477	2,724,550	996,513	1,831,309	734,176
Table, kitchen, and hospital utensils, and other similar hollow ware	77,509	46,805	86,114	48,815	37,129	23,747
Other manufactures	(3)	43,467	(3)	57,266	(3)	34,915
	(3)	1,016,303	(3)	1,295,061	(3)	887,624
Grand total	(3)	5,181,264	(3)	8,177,600	(3)	3,379,018

1 1936: 43,260,596 leaves; 1937: 29,279,568 leaves; 1938: 8,389,969 leaves; equivalent in pounds not recorded.
2 1936: 177,916 leaves; 1937: 54,150 leaves; equivalent in pounds not recorded.
3 Quantity not recorded.

9 Anderson, Robert J., Long-Term Prices of Aluminum: Metallurgia, vol. 19, No. 112, February 1939, pp. 142–146.

Aluminum exported from the United States, 1936–38, by classes

Class	1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value
Crude and semicrude:						
Ingots, scrap, and alloys	953,546	$129,808	4,719,034	$967,342	9,670,398	$1,860,796
Plates, sheets, bars, strips, and rods	652,207	252,016	664,482	293,453	2,947,680	2,050,995
	1,605,753	381,824	5,383,516	1,260,795	12,618,078	3,911,791
Manufactures:						
Tubes, moldings, castings, and other shapes	901,584	318,287	588,960	279,361	576,377	313,758
Table, kitchen, and hospital utensils	554,961	301,051	765,810	411,864	672,290	364,240
Foil	(1)	(1)	422,850	121,269	144,999	66,771
Aluminum and aluminum bronze powder	(1)	(1)	316,482	114,760	82,232	33,944
Other manufactures of aluminum	(2)	608,166	(2)	755,165	(2)	793,543
	(2)	1,227,504	(2)	1,682,419	(2)	1,572,256
Grand total	(2)	1,609,328	(2)	2,943,214	(2)	5,484,047

1 Not separately recorded.
2 Quantity not recorded.

TECHNOLOGIC DEVELOPMENTS

The increasing use of bauxite as an adsorbent for the percolation filtration of paraffin-base oils is based largely upon its property of indefinite revivification without substantial degradation in adsorptive power. The effect of continued revivification upon both the decolorizing value and the "solvent" action of bauxite is discussed by Hubbell and Ferguson.[10] The specifications for bauxite to be used in oil refining comprise high capacity for removing color bodies and other impurities from lubricating oil, high resistance to abrasion, and a high inherent structural strength, including the ability to resist the disintegrating action of steam.

The Bureau of Mines has developed a process for the recovery of alumina, potassium sulfate, and some excess sulfuric acid from alunite [11] derived from the Marysvale (Utah) region.[12] Briefly, the alunite is sintered with boric acid and then leached with water to remove the potash and excess boric oxide, which are separated by brine flotation. The alumina is recovered by sulfuric acid leaching of the water-insoluble residue from the sinter and is precipitated electrolytically from the aluminum sulfate solution. Among the recent United States patents for the production of alumina are Nos. 2,123,650 and 2,127,504, on the treatment of clays, bauxite, etc., and Nos. 2,119,551 [13] and 2,134,793, on the treatment of alunite, etc. A loan of $50,000 has been authorized by the Reconstruction Finance Corporation to Aluminum, Inc., Marysvale, Utah, for completion of a plant using the last of these patents.

10 Hubbell, R. H., Jr., and Ferguson, R. P., Revivification Characteristics of Bauxite Used in Percolation Filtration: Presented at 19th Ann. Meeting, Am. Petrol. Inst., Chicago, Nov. 18, 1938.
11 Koster, J., Knickerbocker, R. G., Fox, A. L., and Perry, P. R., Recovery of Potassium Sulfate and Alumina from Alunite by Fusion with Boric Acid; Progress Reports—Metallurgical Division, No. 30, Electrometallurgical Investigations: Bureau of Mines, Rept. of Investigations 3438, 1939, 15 pp.
12 Callaghan, Eugene, Preliminary Report on the Alunite Deposits of the Marysvale Region, Utah: Geol. Survey Bull. 886–D, 1938, pp. 91–134.
13 Light Metals, Alunite—A New Source of Aluminum: Vol. 2, No. 14, March 1939, p. 115.

A recent report describes a process whereby ferruginous bauxite is treated with an excess of sulfur at high temperature and the resultant sulfides are chlorinated to yield aluminum chloride for use in the aluminum industry.[14]

The Carborundum Co. has announced a process for casting fused alumina refractories without a bond. A boroaluminate with a hardness of 7 to 7.5, high electrical resistance, and low thermal expansion is now being produced. In addition the company has devised a thermal microscope to study abrasive and refractory materials at temperatures above 2,000° C.[15]

The black appearance of aluminum utensils used in hot, slightly alkaline tap water has been found to be due to a purely optical phenomenon caused by a submicroscopic etching of the surface. As there is no superficial coating, corrosion resistance is unchanged. The etched surface has no hygienic or other disadvantages.[16]

Steel can be protected from corrosion by spraying, plate rolling, hot-dip plating, or calorizing aluminum on its surface.[17] The formation of the brittle compound $FeAl_3$ on plated steel can be avoided by the addition of a little silicon to the aluminum and by increasing the nitrogen and oxygen content of the steel. Aluminum can be deposited on iron and copper in a reducing atmosphere containing aluminum chloride gas at a temperature of 750° to 1,100° C. by the Martin process.[18]

The story of the production and uses of aluminum and its products is depicted in two motion-picture films recently produced by the Bureau of Mines in cooperation with the Aluminum Co. of America.

WORLD BAUXITE AND ALUMINUM INDUSTRIES

BAUXITE PRODUCTION

World production of bauxite in 1938 advanced slightly from the previous record established in 1937. The 1938 output is estimated as 3,850,000 metric tons, an increase of 5 percent over 1937. The principal producing countries, in the probable order of importance, were: France, Hungary, British Guiana, Yugoslavia, Italy, Surinam, the United States, the U. S. S. R., and Netherland India. Estimates for 1938 indicate that British Guiana increased its bauxite production approximately 51 percent, Hungary 20 percent, the U. S. S. R. 17 percent, Netherland India 16 percent, and Yugoslavia 12 percent.

[14] Fink, Colin G., and de Marchi, V. S., Beneficiating Ferruginous Bauxite Through Chlorination: Trans. Electro-chemical Soc., vol. 74, October 1938, pp. 469–494.

[15] Tone, Frank J., The Quest For Hard Materials: Ind. and Eng. Chem., vol. 30, No. 2, February 1938, pp. 241–242.

[16] Fischer, J., and Geller, W., The Blackening of Aluminum by Hot Tap Water: Ztschr. Metallk., vol. 30, No. 6, June 1938, pp. 192–195.

[17] Hoff, H., Aluminum as a Surface Protection for Steel: Stahl u. Eisen, vol. 58, No. 21, May 26, 1938, pp. 565–568.

[18] Steel, Metallic Coatings: Vol. 102, No. 25, June 20, 1938, pp. 60–65.

World production of bauxite, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Australia:					
New South Wales	161	111		6,793	(1)
Victoria	970	1,064	752	1,097	1,341
Brazil [2]			7,000	8,770	12,928
British Guiana [2]	51,417	113,290	172,884	305,533	(1)
Czechoslovakia				846	(1)
France	528,400	512,850	649,500	688,200	682,440
Germany	6,560	8,547	12,425	18,212	(1)
Greece		9,489	129,898	137,412	(1)
Hungary	184,991	211,079	329,091	451,576	540,717
India, British	18	7,758	3,702	15,393	(1)
Indochina			30	7,000	(1)
Italy	131,266	170,064	262,246	386,495	383,000
Netherland India		16,708	133,731	198,970	(1)
Portuguese East Africa		30	29		(1)
Rumania	1,458	6,218	10,829	10,701	(1)
Surinam (Dutch Guiana)	103,338	112,682	234,845	392,447	371,632
Unfederated Malay States: Johore			37	19,305	(1)
U. S. S. R.	61,000	132,000	203,200	[3] 230,000	(1)
United Kingdom: Northern Ireland	58				(1)
United States [4]	172,080	251,341	388,945	446,046	329,015
Yugoslavia	84,828	216,197	292,174	354,233	396,368
	1,327,000	1,769,000	2,831,000	3,679,000	(1)

[1] Data not available. [2] Exports. [3] Estimated. [4] Dried bauxite equivalent.

ALUMINUM PRODUCTION

The world production of aluminum in 1938 exceeded the 1937 record by approximately 17 percent. Production in 1938 is estimated as 561,800 metric tons. Germany took the lead as the foremost producer in 1938, increasing its output approximately 27 percent over 1937, whereas the United States, leader in 1937, decreased its output 2 percent. Japan increased its output 44 percent over 1937, Canada 32 percent, France 25 percent, the United Kingdom 24 percent, Norway 22 percent, the U. S. S. R. 20 percent, Switzerland 17 percent, and Italy 13 percent. The world's capacity for producing aluminum is expected to reach 840,000 tons by 1940.[19]

World production of aluminum, 1934–38, by countries, in metric tons

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Canada	15,800	21,400	26,200	41,700	[1] 55,000
France	15,100	22,000	29,700	34,500	43,000
Germany	37,200	70,800	97,200	127,200	161,100
Austria	2,100	2,200	3,000	4,000	[1] 4,500
Hungary		300	800	1,000	1,500
Italy	12,800	13,800	15,900	22,900	25,800
Japan	700	4,000	[1] 6,700	[1] 9,000	[1] 13,000
Norway	15,300	15,000	15,400	23,000	28,000
Spain	1,200	1,200	600		[1] 800
Sweden	300	1,800	1,800	1,800	1,800
Switzerland	8,200	11,700	13,400	24,000	28,000
U. S. S. R.	14,400	25,500	30,000	40,000	43,900
United Kingdom	12,900	15,100	16,300	19,400	24,000
United States	33,600	54,100	102,000	132,800	130,100
Yugoslavia				200	[1] 1,300
	169,600	258,900	359,000	481,500	[1] 561,800

[1] Estimated production.

[19] Anderson, Robert J., World Capacity for Aluminum Production: Metallurgia, vol. 19, No. 110. December 1938, pp. 65–68.

ALUMINUM CONSUMPTION

According to the Metallgesellschaft world consumption of aluminum in 1937 totaled 501,700 metric tons, a 26-percent increase over 1936. Europe consumed 63 percent of the total. The apparent consumption of the seven largest users of aluminum in 1938 (partly estimated) was as follows: Greater Germany 161,000 tons, the United States 81,213, the United Kingdom 66,000, the U. S. S. R. 56,000, Japan 40,000, France 30,000, and Italy 28,000. The United States was the only large world consumer to show a decline (47 percent) in 1938.

REVIEW BY COUNTRIES

Brazil.—Bauxite reserves of the Poços de Caldas Plateau,[20] chiefly in Minas Geraes, are conservatively estimated at 20,000,000 metric tons. The Companhia Geral de Minas, the principal producer, washes, crushes, dries, pulverizes, and packs in bags the bauxite that it exports to Buenos Aires, Argentina, for the manufacture of aluminum sulfate. The ore shipped averages 60 to 65 percent Al_2O_3, 1 to 2 percent SiO_2, 4 to 6 percent Fe_2O_3, 1 to 2 percent TiO_2, and 28 to 31 percent combined water. However, about 90 percent of the Poços de Caldas ore averages only 54 to 60 percent Al_2O_3, 2 to 5 percent SiO_2, 7 to 10 percent Fe_2O_3, 1 to 2 percent TiO_2, and 28 to 32 percent combined water. The large bauxite deposits near Ouro Preto, also in Minas Geraes, are soon to be mined by the Companhia Electro-Chimica Brasileira.

Favorably located bauxite deposits are being prospected in the state of Rio de Janeiro near Itatiaya,[21] which is close to a railroad. The M. C. Fonseca e Companhia, operating the Muquy deposits,[22] João Pessoa County, Espirito Santo, recently began to ship crushed ore by rail to Rio de Janeiro. There are large reserves of bauxite in five other States in Brazil, but they have not been developed. In Maranhão about 10,000,000 tons of bauxite occur on Trauhyra Island and along both banks of the Gurupy River.

Although railroads are near some of the Brazilian bauxite deposits, transportation is a problem because of the shortage of freight cars and the differences in gage of track. Thus, the low cost of mining ($0.55) and processing ($2.42) is offset by the high cost of freight and loading, and the total cost of delivering processed bauxite, f. o. b. Santos, is about $7 per metric ton. The ore sells for $8.80 to $11.00 per ton, f. o. b. Santos, and $6.60 to $9.90, f. o. b. Rio de Janeiro.

British Guiana.—The 1938 production of the Demerara Bauxite Co., Ltd., in the Christianburg-Akyma field, totaled 454,549 metric tons of bauxite containing 60 percent Al_2O_3 and 117,502 tons of lower-grade ore (mostly 30 to 50 percent Al_2O_3). The Berbice Co., Ltd., affiliated with the American Cyanamid & Chemical Corporation, obtained a concession on 4,000 acres of bauxite land about 125 miles up the Berbice River from New Amsterdam. Other foreign bauxite holdings of the chemical concern are in the Para district, Surinam. A recent bulletin [23] on the British Guiana bauxite deposits describes

[20] Pinto, M. S., Bauxita em Poços de Caldas: Dept. Nacional da Producção Mineral Bull. 22, 1938.
[21] Pinto, M. S., Descoberta de Ocorrência de Bauxita no Itatiaya: Mineração e Metallurgia, vol. 3, No. 15, 1938, p. 183.
[22] Bromirsky, A., Bauxita em Muquy, Espirito Santo: Mineração e Metallurgia, vol. 2, No. 7, May-June 1937, p. 45.
[23] Bishopp, D. W., Memorandum on the Occurrence of Bauxite in British Guiana: Geol. Survey of British Guiana Bull. 8, Georgetown, 1938, pp. 49-54.

a fairly reliable field test, based upon loss on ignition at a red heat, to distinguish gibbsitic bauxite from lithomarge or other indurated earths and clays.

British India.—The Aluminium Production Co. (India), Ltd., (Indian capital) plans to construct an aluminum-reduction works near Asansol, Bengal, and a rolling mill at Belur. Coal is available near Asansol, and bauxite may be obtained from the Ranchi district, Bihar and Orissa. Aluminium, Ltd. (Canadian), and the British Aluminium Co., Ltd., jointly propose to erect similar facilities in India.

Canada.—Exports as well as production of aluminum established a new record in Canada in 1938. Exports totaled 58,717 metric tons compared with 44,000 tons in 1937. Of the 1938 exports, 30,765 tons went to the United Kingdom, 14,105 to Japan, 5,621 to Germany, 1,934 to the U. S. S. R., 1,620 to Sweden, 1,518 to China, 1,013 to the United States, and 890 to Norway. Some shipments to Japan were sent via Portland, Maine. Canadian imports of bauxite, alumina, and cryolite increased from 282,093 metric tons in 1937 to 339,949 in 1938. British Guiana bauxite comprised 84 percent of the total imports.

Expansion of the aluminum-reduction and alumina plants of the Aluminum Co. of Canada at Arvida, Quebec, was completed in 1938. Fabrication facilities are to be extended at Toronto to provide for more products used in the aircraft industry. In 1938 the hydroelectric properties and power sites on the Saguenay River belonging to Alcoa Power Co., Ltd., were sold to the Aluminum Power Co., Ltd., a subsidiary of Aluminium, Ltd.

China.—The Hsin Chung Kungssu (Japanese) has obtained permission from the Kailan Mining Administration to exploit bauxite deposits in North China. Large deposits are said to occur in Kaiping, Tzechwan, and Poshan.

France.—The capacity of French aluminum-reduction plants is to be expanded from 45,000 to 55,000 metric tons in 1939.[24]

The capacity of the alumina plant at La Barasse was expanded in 1938. Of 13 companies in France, 4 produce most of the bauxite output.[25] The underground and open-pit mining methods employed in the bauxite mines were recently described.[26]

Bauxite exports totaled 291,684 tons in 1938 (301,601 in 1937), of which the United Kingdom received 187,963 tons, Germany 84,075, and Sweden 13,923. Alumina exports totaled 21,770 tons (27,158 in 1937), of which Switzerland received 16,026 and Norway 5,264. Exports of crude and semicrude aluminum increased from 9,031 tons in 1937 to 16,560 in 1938.

French Guinea.—The bauxite deposits on the isle of Tamara in the Los Islands group, estimated to contain 20,000,000 tons, were developed in 1938 by Société Anonyme des Bauxites du Midi (Canadian). A geological survey of the vast bauxite resources on the mainland of French Guinea[27] is to be made.

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[24] d'Auvigny, M. Henri, The French Aluminum Industry: Light Metals, vol. 1, No. 10, November 1938, pp. 351–353.

[25] Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 4, Oct. 20, 1938, pp. 2–3.

[26] Nicholas, W. L. J., Bauxite Mining in France: Mine and Quarry Eng., London, vol. 3, No. 5, May 1938, pp. 175–183.

[27] Goloubinow, R., Les bauxites de Tougue: French West Africa Service du Mines, Bull. 1, 1938, pp. 77–80. Chételat, E., Le Modelé latéritique de l'ouest de la Guinée Française: Rev. géog. physique et géol. dynamique (Paris), vol. 11, No. 1, 1938, 125 pp. Lapperent, J., Laterites de L'Afrique Occidentale: Compt. rend. July 18, 1938.

Germany.—Although the largest producer of aluminum in 1938, Germany had to import an additional 14,521 metric tons of crude metal (only 3,645 tons in 1937) to serve domestic requirements. The import duty on aluminum was lifted until March 31, 1939. Exports of crude metal increased from 1,334 to 2,831 tons, but those of fabricated metal decreased from 15,920 to 15,096 tons.

The State-owned Vereinigte Aluminiumwerke A. G. produced approximately three-fourths of the total German aluminum output at Lautawerk, Toging-am-Inn, and Grevenbroich (Niederrhein); the balance was produced by Aluminiumwerke G. m. b. H. at Bitterfeld and Aluminium G. m. b. H. at Rheinfelden (Rhein). In 1938 the capacity of the Rheinfelden plant was extended to 23,000 tons annually, a new aluminum-refining plant was constructed at Lautawerk, and expansion of the Austrian aluminum-reduction plants at Steeg and Lend was contemplated. Reports state that in 1939 approximately 8,000 tons of alumina will be produced from clay at the large-scale experimental plant built at Lippe. Although the recovery of alumina from clay is costly, this source of supply can be relied upon in an emergency.

Bauxite imports dropped from 1,313,152 tons in 1937 to 1,184,647 in 1938. Of the 1938 imports, 363,256 tons came from Hungary, 348,068 from Yugoslavia, 192,668 from Netherland India, 96,593 from Italy, 92,272 from France, 84,796 from Greece, and 6,994 from Denmark (probably cryolite). Imports from Netherland India increased 39 percent compared with those in 1937, whereas imports from Hungary, Yugoslavia, and Italy decreased substantially. Bauxite deposits in the Laussa Valley of German Austria may be mined in the future.

Hungary.—The large bauxite production of Hungary (reported at 540,717 metric tons in 1938) is derived from two open-pit mines worked near Gánt by Aluminiumérc, Bánya és Ipar R. T. of Budapest. Here a continuous layer of red bauxite, from 50 to 100 feet thick, is underlain by an uneven surface of Triassic dolomite and overlain in part by Tertiary clay and limestone strata of varying thickness. Faults have been important in localizing the bauxite areas, having preserved them from recent erosion.[28] Another aluminum-reduction plant with an annual capacity of 1,000 tons is to be completed in 1939 near Totis by the Hungarian United Coal Mining Co., Ltd.

Indochina.—The bauxite produced in Indochina, probably derived from the Dragon mine in the Province of Lang-son, is exported to Japan.[29]

Italy.—The aluminum-reduction plant of the Società Alluminio Italiano (Canadian) at Borgofranco d'Ivrea will be expanded to an annual capacity of 4,000 tons in 1939. The capacity of synthetic cryolite and alumina plants at Porto Marghera also are to be increased. In 1938, Italy exported 75,386 metric tons of bauxite to Germany and 39,616 tons of alumina, chiefly to Switzerland and Germany. The Società Bauxiti Istriane (a Montecatini subsidiary) began mining bauxite near San Giovanni (Apulia), southern Italy. In recent years almost all the bauxite has come from Istria.

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[28] Singewald, Quentin D., Bauxite Deposits at Gánt, Hungary: Econ. Geol., vol. 33, No. 7, November 1938, pp. 730–736.

[29] Génie civil, Les nouvelles substances minérales exploitées en Indochine. La Bauxite: Paris, vol. 112, No. 10, March 1938, p. 214.

Japan.—The nationalization of the electrical industry of Japan is expected to result in large extensions and consolidations in aluminum and magnesium production facilities. The Japan Aluminium Co. plans to increase aluminum output at its Takao plant from 6,000 to 8,000 metric tons, and construction has begun on a new reduction plant of 8,000 tons annual capacity at Beiron, Karenko City, East Taiwan.[30] With the financial backing of large Japanese industrial and power concerns and protection of the government, the Japan Light Metals Co. proposes to erect alumina and aluminum plants in several parts of Greater Japan. The proposals call for an alumina plant of 120,000-ton annual capacity at Shimizu and an aluminum-reduction works at Kambra, both in Shizuoka Prefecture. The Nitto Chemical Industrial Co. plans to utilize an aluminous phosphate ore from Manchuria in the production of aluminum at Hachinohe, northeastern Japan. Alumina will be extracted from the ore by treatment with sulfuric acid and ammonia gas.

The Japanese producers of aluminum[31] in 1938, in their probable order of importance were: Japan Aluminium Co., Takao, Formosa; Japan Electric Industry Co., Omachi and Yokohama; Sumitomo Aluminium Reduction Co., Niihama; Nichiman Aluminium Co., Iwasemachi; Japan Soda Co., Ltd., Takaoka; and probably the Manchuria Light Metal Co., Fushun, Manchuria. Production is estimated at 13,000 tons compared with 9,000 tons in 1937. More than 21,500 tons of aluminum were exported to Japan in 1938 from Canada, Norway, Germany, and the United States, and consumption of domestic and imported primary and secondary metal probably exceeded 40,000 tons. In Northeastern Korea the Chochinko Hydro-electric Co. began constructing a 220,000-volt transmission line 100 kilometers long with aluminum cable, steel-reinforced.

Netherlands.—In 1938 the N. V. Aluminium Walswerken-en Persbedrijven (Canadian-Dutch) began to erect an aluminum rolling and extrusion plant at Utrecht, at the crossing of the projected Amsterdam-Rhine Canal and the new locks in the Old Rhine. The same interests also formed a company for the production of aluminum, but construction of the reduction plant has not yet started. Interests representing L'Aluminium Français S. A. (French) were denied the privilege of establishing a rival aluminum industry in the Netherlands. The increasing use of aluminum and the geographical position of the Netherlands as a distributing center are given as the reasons for creating the aluminum industry rather than the desire to satisfy the small local consumption (2,307 metric tons of crude and semicrude metal imported in 1938).

Netherland India.—The N. V. Nederlandsche-Indische Bauxiet Exploitatie Maatschappij (NIBEM) produced an estimated 230,000 metric tons of bauxite in 1938 on the island of Bintan, where construction was completed on a bauxite washing and drying plant and on an overhead cableway connecting it with the new bauxite deposits on the islands of Angkoet and Kojang.

Early in 1939 the N. V. Billiton Maatschappij, the parent concern of NIBEM, and the N. V. Gem. Mijnbouwmij Billiton sought capital to establish an aluminum industry in Netherland India. Preliminary plans call for the construction of an alumina plant, probably at

[30] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, p. 2.
[31] Anderson, Robert J. The Aluminum Industry of Japan: Min. Mag. (London), vol. 59, No. 2, August 1938, pp. 73–85.

Palembang, Sumatra, near the Boekit Asem coal mines; an aluminum-reduction works on the east coast of Sumatra which can utilize the water powers of the Asahan River; and fabricating works in Java at Djokjasche.

Norway.—In 1938 imports of bauxite into Norway totaled 25,942 metric tons (40,474 in 1937) and of alumina, 43,738 tons (38,016 in 1937). Exports of crude aluminum increased from 21,503 tons in 1937 to 28,577 in 1938, of which 5,325 tons went to the United Kingdom, 5,014 to Japan, 3,190 to the U. S. S. R., 2,700 to Greater Germany, 2,610 to Sweden, 2,427 to the United States, and the rest chiefly to Denmark, Switzerland, Czechoslovakia, Belgium, and Brazil.

Poland.—An aluminum-reduction works is to be constructed near Sandomir.

Surinam (Dutch Guiana).—In 1938 the Surinaamsche Bauxite Maatschappij shipped 377,595 metric tons of bauxite from its mines at Moengo Hill on the Cottica River. Another bauxite property is to be developed by the company in 1939 in the Para district about 25 miles south of Paramaribo. Bauxite mined at Topibo Hill will be transported by narrow-gage railroad to a crushing, washing, screening, and drying plant to be constructed on the west bank of the Surinam River. Two rotary drying kilns are to be installed with a total capacity of 150 tons per hour. As heretofore, the company will pay a royalty of 12½ cents per ton on bauxite mined and contribute 10 cents per ton on each ton exported, for harbor and river maintenance.[32] The N. V. Billiton Maatschappij is investigating bauxite deposits in the Nassau Mountains and along the Government Railroad, 70 miles south of Paramaribo.

Sweden.—The AB. Swenska Aluminiumkompaniet, operating the aluminum-reduction works at Månsbo, plans to establish an alumina plant in Sweden.

Switzerland.—The Neuhausen Co. (AIAG) increased its output in 1938 at Chippis and started producing aluminum of 99.99-percent purity. Outside of Switzerland the capacity of company plants was increased in Greater Germany and Italy, and an interest was obtained in a new aluminum-reduction works under construction in the United Kingdom. Its plants in France were handicapped by labor difficulties. The Lend (Austria) reduction works probably will be converted into an independent subsidiary, as was done at the Rheinfelden (Germany) works.

In 1937 the Aluminum Cartel, the Alliance Aluminium Cie. (Basel), liquidated its available stock and abolished output curtailment measures. Since then European demand for aluminum has been greater than the supply.

Unfederated Malay States: Johore.—Bauxite mined at the Pasir mine, Batu Pahat, is exported to Japan by the Ishiwara Sangyo K. K. The area in the vicinity of Kuantan, Tanjong, and Changkat Pandan in Pahang is being prospected for bauxite.

U. S. S. R.—In 1938 the Volkhov and Dnepr aluminum-reduction plants produced about 44,000 metric tons of metal compared with 40,000 in 1937. The alumina process at the Dnepr works was modified, and preparations were made for the utilization of nepheline at the Tikhvin alumina works. Improvements were made in the

[32] American Metal Market, New York, vol. 45, No. 103, May 27, 1938, p. 5.

recovery of alumina from bauxite (70-percent recovery) and in the consumption of electric energy per ton of aluminum produced. In 1939 the Government plans to invest considerable capital in the industry and obtain higher efficiency in the use of raw material, power, and labor. The new alumina and reduction plants at Kamensk are scheduled to start operations in 1939. A modern, closed-type reduction furnace, with self-baking electrode operating on 50,000 amperes, will be employed.[33] Before 1942 new aluminum works are to be constructed in Kandalaksha and at Rybinsk, Siberia.

The bauxite deposits in the North and South Urals and near Tikhvin produced an estimated 270,000 tons in 1938. New bauxite discoveries are reported in the Bashkiria Republic, at Aktiubinsk east of the Urals, and near Tula, Central Russia. The All-Union Institute of Heat Technology reports that 23 to 40 percent alumina could be recovered from Soviet lignite ashes.

United Kingdom.—Imports of crude aluminum and its alloys into the United Kingdom totaled 46,996 tons in 1938 compared with 32,079 in 1937. Of the 1938 imports, 30,902 tons came from Canada, 9,699 from Switzerland, and 5,434 from Norway. Imports of bauxite increased from 222,953 tons in 1937 to 252,925 in 1938.

During 1938 the British Aluminium Co., Ltd., continued its program announced in 1937 of expanding alumina and aluminum production capacity. The alumina plant at Burntisland, Scotland, was completed and is working at full capacity to meet demands of the new reduction furnaces at Lochaber, Scotland. The alumina plant at Newport, Wales, was nearly completed, and fabrication facilities at Banbury, England, are being extended considerably. Aluminium, Ltd., established a research laboratory at Banbury in 1938. British, Canadian, and Swiss interests formed the South Wales Aluminium Co., Ltd., which began to construct an aluminum-reduction plant early in 1939 at Resolven in the Neath Valley, Glamorganshire, South Wales.

Yugoslavia.—The capacity of the new reduction plant at Lozovac near Sibenik is to be increased to 2,000 tons of aluminum annually. Most of the metal has been exported to the United Kingdom. Another alumina plant (in addition to the one at Ljubljana) is under construction at Lozovac by Aluminiumfabrik A. G. In 1938 the Dalmacia-Bauxit Co. of Split began to work a new bauxite deposit at Donja Suhaja, near Bosanska Krupa; and two new bauxite mining companies, the Pan Bauxit Co. (German) and the Ugrovaca Mining Co. of Zagreb (Swiss), began exploration work in the Siroka Breg Mountains near Mostar.

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[33] Behr, A., Development and Research in the Russian Aluminum Industry: Metallurgia, vol. 19, No. 112, February 1939, pp. 137–138.

MERCURY

By H. M. Meyer

SUMMARY OUTLINE

Normal international trade in mercury was hampered again in 1938 by the civil war in Spain, where the principal mercury reserves of the world are situated. Although the war continued to restrict production in Spain, world supplies of metal were more than ample for consumption requirements even though demand in Germany and the United Kingdom surpassed the high rates attained in 1937. Italian production duplicated the record rate achieved in 1937, but exports dropped from 67,075 flasks in 1937 to 55,327 in 1938. Exports from Spain were reported to have increased from 28,357 flasks in 1937 to approximately 40,000 in 1938, so indications are that Spain supplied a larger share of world requirements in 1938 than in 1937. Consumption in the United States was markedly lower in 1938 with production only 9 percent above the 1937 rate and imports 88 percent less than in 1937. Another source of foreign metal for consumption, which is not revealed by import statistics, is the mercury produced in this country from concentrates received from Mexico. Metal from this source totaled more than 2,600 flasks in 1938. In addition, actual consumption of mercury in the United States probably was higher than available figures indicate owing to a reduction in consumers' stocks. Consumers' stocks are believed to have been built up considerably during the late months of 1936 and early in 1937, when a world shortage of metal, which never materialized, was threatened.

The year 1938 was marked by the strenuous efforts of the Rebel forces in Spain to win possession of the Almaden mine and by the stubborn resistance of the Loyalist forces. The stiffening of prices early in 1939 probably was due partly to additional demands for mercury caused by world-wide fear of war. It also suggests that the defeat of the Loyalist Government forecasts closer cooperation between Italian and Spanish producers in regard to the marketing of supplies rather than a return to the competitive methods that prevailed before the formation of Mercurio Europeo.

Although to most domestic producers, 1938 was unsatisfactory, the situation at the end of the year was much more favorable than at the beginning. In January 1938 consumption was low and prices were falling. In December, on the contrary, demand was improving and prices were rising.

Notes on advances in the metallurgy of quicksilver since the World War were published by Ransome [1] early in 1939.

Wehrly [2] has prepared an article that contains much information on uses of mercury. Regarding specifications for mercury, Wehrly states:

The relative low tenor of cinnabar ores—8 percent in Spain, ½ to 2 percent in Italy, 1 percent in Mexico, and less than ½ percent in the United States—precludes transportation to a custom smelter, hence the mine must be a complete unit. The only exception is a recent experiment in which hand-picked Mexican ore was sent to this country for reduction.

The quality of the mercury so produced is exceptionally pure. Random assays show well over 99.5 percent and as high as 99.9 percent with dirt and oil from the insides of the flask as the only mechanical impurities. It is peculiar that no standard has been set by the industry—a fact probably caused by this unusual degree of purity. The U. S. P. states that mercury should test at least 99.5 percent. One large user, who if he actually received such impure metal would reject it, calls for 95 percent. Conversely another company has set up specifications which cannot be met with commercial metal. Further purification is not necessary in the majority of cases, and mechanical cleaning will suffice. Commercial mercury is termed "prime virgin" and is packed in iron or steel flasks containing a net weight of 76 pounds (34.5 kilograms). Exceptional uses may require redistilled or triple-distilled mercury, in which latter case the purity exceeds 99.9 percent plus with a nonvolatile content of not over 0.002 percent. The redistilled type is sold in earthenware or glass jugs containing 5, 10 or 20 pounds.

United States Patent 2,119,231, issued May 31, 1938, covers a process for recovering mercury from antimony-bearing ores.

Salient statistics of the mercury industry in the United States, 1934–38

[Flasks of 76 pounds]

	1934	1935	1936	1937	1938
Production .... flasks	15,445	17,518	16,569	16,508	17,991
Number of producing mines	93	90	87	101	91
Average price per flask:					
New York	$73.87	$71.99	$79.92	$90.18	$75.47
London	$56.15	$60.74	$64.33	$69.65	$66.92
Imports for consumption:					
Pounds	774,564	593,904	1,374,652	1,437,712	179,522
Equivalent flasks	10,192	7,815	18,088	18,917	2,362
Exports:					
Pounds	(1)	(1)	19,980	34,485	54,161
Equivalent flasks	(1)	(1)	263	454	713
Apparent new supply .... flasks	25,400	25,200	34,400	35,000	19,600
From domestic mines .... percent	60	69	47	46	88
Stocks in warehouses (bonded) at end of year .... flasks	4,346	3,582	2,513	4,286	553

1 Not separately classified for 1934–35.

REPORT ON STRATEGIC MINERALS

A joint report on certain deficient strategic minerals was prepared by the staffs of the Geological Survey and the Bureau of Mines and published in February 1939. Because of the importance of strategic minerals and the interest in them, particularly at present, the text on mercury and two historical tables are quoted as follows:

General.—The normal annual consumption of mercury in the United States in recent years has ranged from 25,000 to 35,000 flasks of 76 pounds each, of which about half has been imported. Mercury is used in the manufacture of fulminate,

1 Ransome, Alfred L., Quicksilver Metallurgy Today: Eng. and Min. Jour., vol. 140, No. 4, April 1939, pp. 46–49.

2 Wehrly, Chas. S., Mercury Down the Ages Part 2: Chem. Ind., vol. 44, No. 3, March 1939, pp. 257–260.

for detonating high explosives and fixed ammunition, for gold recovery by amalgamation, in drugs (calomel, corrosive sublimate, etc.), dental amalgam, antifouling paint for ship bottoms, storage batteries, barometers, etc. Substitutes for some of these purposes may be used, but none is known for the greater part of the consumption.

Production, imports, exports, and apparent new supply of mercury in the United States, 1910–38, in flasks of 76 pounds

Year	Production	Imports for consumption	Exports	Apparent new supply	Year	Production	Imports for consumption	Exports	Apparent new supply
1910	20,330	9	1,898	18,441	1925	9,053	20,580	201	29,432
1911	20,976	6,209	287	26,898	1926	7,541	25,634	114	33,061
1912	24,734	1,088	306	25,516	1927	11,128	19,941	(1)	[2] 30,900
1913	19,947	2,259	1,125	21,081	1928	17,870	14,562	(1)	[2] 32,300
1914	16,330	8,090	1,427	22,993	1929	23,682	14,917	(1)	[2] 38,500
1915	20,756	5,551	3,328	22,979	1930	21,553	3,725	(1)	[2] 25,200
1916	29,538	5,585	8,763	26,360	1931	24,947	549	[3] 4,984	20,512
1917	35,683	5,138	10,636	30,185	1932	12,622	3,886	[3] 214	16,294
1918	32,450	6,631	3,057	36,024	1933	9,669	20,315	(1)	[2] 29,700
1919	21,133	10,495	8,987	22,641	1934	15,445	10,192	(1)	[2] 25,400
1920	13,216	13,982	1,533	25,665	1935	17,518	7,815	(1)	[2] 25,200
1921	6,256	10,462	388	16,330	1936	16,569	18,088	263	34,400
1922	6,291	16,697	287	22,701	1937	16,508	18,917	454	35,000
1923	7,833	17,836	314	25,355	1938	17,991	2,362	713	19,600
1924	9,952	12,996	205	22,743					

[1] Not separately classified for 1927–30 and 1933–35.
[2] Estimated by the Bureau of Mines.
[3] From a special compilation by the customs statistics section, Bureau of Foreign and Domestic Commerce.

Sources.—Mercury mining in the United States began in California about 1846, and for many years deposits in that State yielded all of the domestic production. Even though many deposits in other States have been productive (chiefly Texas, Oregon, and Nevada), the mines in California consistently ship more than those of any other State. For most of the years from 1850 to 1870, a single mine (New Almaden) yielded 70 to 90 percent of the output of California, which was almost the entire domestic production. Domestic production attained the annual maximum of 80,000 flasks in 1877, and from 1880 to 1919 it generally ranged from 20,000 to 35,000 flasks. Prior to 1919, domestic production usually yielded a surplus for export, but since then imports have generally been needed to meet consumption. During the last 5 years (1933–37) production and imports have been about equal. An import duty on mercury was first imposed in 1883, and since 1922 it has been 25 cents a pound or $19 a flask.

The principal mercury mineral is the sulfide, cinnabar, and the recovery processes are designed to extract mercury only, since mercury is rarely present in the ores of the other metals. As almost every mine is equipped with a recovery plant, metallic mercury is shipped direct to the market, and mine production tends to respond quickly to changes in price. The ore bodies have diverse shapes and sizes, but most of them are tabular and dip steeply into the earth. All mines yield some high-grade ore, but the steady decline in grade through the years has necessitated improvements in mining and treatment. Most of the ore now treated at domestic mines contains from 3 to 10 pounds of mercury per ton of ore.

Several efforts have been made to appraise the reserves of mercury in some Western States. One estimate made in 1931 indicated about 175,000 flasks in six States, but from 1931 to 1937, inclusive, nearly 115,000 flasks were produced. It is unusual to find blocked-out reserves in any mercury mine, and for this reason it is almost impossible to estimate mercury resources with any degree of accuracy. Three active districts in California and one in Nevada were studied by Federal geologists in 1938. A study of the history of production at numerous mines, taking into account their geologic features and environment, as well as prevailing technique and prices, indicates that dependable forecasts of production at several assumed prices can be made.

Production from domestic mines.—The latest summary of the mercury deposits of California (1918) records about 125 mines or groups of mines, as well as many more prospects, in 39 counties; practically all of the output, however, has been derived from seven counties. One mine (New Almaden) has yielded nearly half the total of the State, but it has been idle in recent years. The peak of production appeared in 1877, and the peaks for the six outstanding counties appeared between 1865 and 1881. Even though it cannot be stated that no new large deposits will be discovered, it appears unlikely that the output of domestic mines will approach again the record for 1877. Experience in most mines shows that the grade of ore treated has steadily declined and now rarely exceeds 10 pounds of Mercury to the ton. In many mines the tenor of most of the ore ranges from 3 to 5 pounds to the ton. Without the benefit of the tariff of 25 cents a pound, imposed in 1922, it is doubtful whether any mines in the State would be active.

Mercury produced in the United States, 1910-38, by States

[Flasks of 76 pounds]

Year	California	Texas	Oregon	Nevada	Other States [1]	Total
1910	16,985	3,276		69		20,330
1911	18,612	2,295		69		20,976
1912	20,254	1,964		2,516		24,734
1913	15,386	2,714		1,623	224	19,947
1914	11,154	3,103		2,062	11	16,330
1915	14,095	4,359	(2)	2,296	6	20,756
1916	20,768	6,223	299	2,169	79	29,538
1917	23,623	10,649	383	984	44	35,683
1918	22,366	8,340	693	1,030	21	32,450
1919	15,005	4,953	429	746		21,133
1920	9,719	3,391	24	82		13,216
1921	3,015	(2)	(2)	(2)	3,241	6,256
1922	3,360	(2)	2	(2)	2,929	6,291
1923	5,375	(2)	(2)	(2)	2,458	7,833
1924	7,861	(2)	(2)	(2)	2,091	9,952
1925	7,514	(2)		532	1,007	9,053
1926	5,651	(2)		194	1,696	7,541
1927	5,672	(2)	2,055	419	2,982	11,128
1928	6,977	(2)	3,710	2,867	4,316	17,870
1929	10,139	(2)	3,657	4,764	5,122	23,682
1930	11,451	(2)	2,919	3,282	3,901	21,553
1931	13,448	(2)	5,011	2,217	4,271	24,947
1932	5,172	(2)	2,523	474	4,453	12,622
1933	3,930	(2)	1,342	387	4,010	9,669
1934	7,808	(2)	3,460	300	3,877	15,445
1935	9,271	(2)	3,456	190	4,601	17,518
1936	8,693	(2)	4,126	211	3,539	16,569
1937	9,743	(2)	4,264	198	2,303	16,508
1938	12,277	(2)	4,610	336	768	17,991

[1] Includes, in addition to States shown as "(2)", Alaska, Arizona, Arkansas, Idaho, Utah, and Washington.
[2] Included with "Other States." Bureau of Mines not at liberty to publish figures separately.

Since 1897, several thousand flasks of mercury have been produced annually from a district of several square miles in area near Terlingua, Tex. Although several mines have been developed in this district, most of the production of about 137,000 flasks has come from one mine.

Mercury was discovered in Oregon as early as 1865, but the State did not become important as a producer of mercury until 1927. Since then, annual production has been fairly constant, and the number of sources has risen steadily. From a recent study of the deposits throughout the State, it appears that if present prices are maintained the current rate of production may be expected to continue for a decade or more.

Even though mercury is recorded widely in Nevada, most of the exploration is confined to 32 districts; of these, only 7 have yielded a product and 2 have yielded well over one-half of the total production. Except in times of high prices, production is small.

Since 1910, annual production has responded closely to price, but the highs and lows of production follow those of price by a year or two.

Expected production of mercury at assumed index prices

Assumed index price per flask mercury, dollars		Flasks
50	First year	6, 000– 8, 000
50	Second year	8, 000–10, 000
50	Third year	8, 000–10, 000
65	First year	12, 000–15, 000
65	Second year	15, 000–18, 000
65	Third year	12, 000–16, 000
85	First year	18, 000–22, 000
85	Second year	22, 000–25, 000
85	Third year	22, 000–25, 000
100	First year	20, 000–22, 000
100	Second year	25, 000–30, 000
100	Third year	25, 000–30, 000

Technologic progress.—Technologic advance in the mercury industry has made it possible to treat ores of successively lower grades. In 1875 the principal domestic producer was the New Almaden mine in California, and the grade of ore produced there averaged 3.35 percent or 67 pounds of mercury per ton. By 1910 the average yield of all ores treated in the United States had declined to 0.63 percent (12.6 pounds), and in recent years it has approximated 0.40 percent (8 pounds). Not all of this decline in grade, however, can be ascribed to technologic improvement, because it is also due in part to the rise of prices resulting from the tariff, first imposed in 1883 and substantially increased in 1922, which has made possible the mining and treatment of lower-grade ores.

Since the World War, production has been derived from an increasing number of small mines. Some of the new developments in mine mechanization have not been applicable to mercury mines because these were too small to warrant the capital investments required. Mercury does not occur typically in extensive low-grade disseminated deposits, so that there is little possibility of applying the large-scale mass production methods used, for example, in copper mining.

Improvement in metallurgical practice has increased recovery and reduced costs in treating mercury ores. The introduction of the Scott furnace in 1875 at New Almaden, Calif., is perhaps the most significant improvement in an art that has been practiced for centuries. This invention permitted continuous treatment of ores and the use of fine sizes which hitherto had been difficult to handle. Subsequently, the need for still lower costs and greater tonnages led to the introduction in 1916 of mechanical furnaces of the multiple-hearth and rotary-kiln types, which now are widely used in the domestic industry. Retorts, which were used extensively prior to 1875, are now employed only for the treatment of special byproducts at furnace plants or at small mines where the high first cost of the more efficient smelting units is not justified. Concentrating methods for treating low-grade ores have not been developed to any great extent, and many authorities believe that improvement in this direction will be limited.

Summarizing, the technique of treating mercury ores has advanced considerably in recent years. Doubtless, additional improvement will be made, but it is believed that the art is approaching maturity and that if technology is to maintain production at the present level it will have to do so through improvements in methods of finding new ore bodies.

National requirements.—The principal military uses for mercury are in the manufacture of fulminate for detonating high explosives, drugs (calomel, corrosive sublimate, etc.), dental amalgam, and antifouling paint for ship bottoms. The apparent consumption of mercury was nearly 24,000 flasks annually in the 5-year period 1912–16. In the war years, 1917–18, consumption averaged 33,000 flasks, or 38 percent higher. The apparent annual consumption for the 10 years ending 1937 amounted to 28,000 flasks. From 1926 to 1929, however, and in 1936 and 1937, consumption exceeded 30,000 flasks. Thus future domestic requirements under normal conditions may be estimated at 35,000 flasks per annum. Assuming an increase of about one-third during a war emergency, the requirements would probably approximate 46,000 flasks annually.

On April 3, 1939, the Senate passed a bill which provides $10,000,000 a year for 3 years, 1940 to 1943, for the purchase of strategic and critical materials for stockpile purposes. A similar bill, which, however, provides a total of $100,000,000 in 4 years, has been reported to the House by the House Military Affairs Committee.

HEALTH HAZARDS

Mercury poisoning has been discussed at length by Neal.[3] Neal listed industries with potential mercury hazards as including the mining of cinnabar, gold, and silver; chemical manufactures of mercury compounds, also of cyanogen and electrolytic chlorine; manufacture of alloy and amalgam; electrical industries of several types; the felt industry; dentistry; chemical and physical laboratories; the manufacture of pharmaceuticals and explosives; decoration of china and porcelain; photography; certain phases of the printing industry; paints; engraving; jewelry; mercury boilers; dry-battery manufacture; gilding; bronzing; and the hardening of steel tools by quenching in mercury. He says mercury poisoning may develop from introduction of mercury through four routes: (1) Inhalation of vapor or dust, (2) ingestion, (3) the skin, and (4) subcutaneous tissues. The first route is the common one in industrial mercury poisoning. The symptoms of the two types of chronic mercury poisoning, threshold dosages, diagnoses, and prevention are discussed.

Prevention of mercury poisoning is described in General Electric Co. Handbook GEQ-104, which gives results of the company's experiences and quotes from Bureau of Mines Bulletin 222 [4] and other sources. The General Electric Co. has developed a mercury vapor detector through which vapors invisible to the human eye cast an ultraviolet shadow. An extremely low ratio of mercury to air (as little as 1 part mercury to 1 billion parts of air) casts the shadow distinctly.

STOCKS

Reliable information indicates that there were no stocks at Spanish ports at the end of 1937 and that little metal was on hand at the Almaden mine. Roura & Forgas were reported to have had 22,000 flasks of mercury in stock in London at the end of 1937. Italian inventories were believed to have been low at that time. Additions were made to Italian stocks in 1938 by the large excess of production over exports, but further data are lacking concerning the other centers. Producers' stocks in the United States were not much in excess of 1,000 flasks at the end of 1938, and stocks in domestic warehouses totaled 553 flasks.

PRICES

The average quoted price for quicksilver at New York in 1938 was 16 percent below that in 1937. Demand was low as the year began, and the average monthly price declined from $79.24 in January to $71.02 in April, the lowest monthly price for the year. Large purchases by a San Francisco bank in April and May, purported in the trade to range from 2,000 to 2,500 flasks, were partly responsible for the rapid advance to $80.73 in June, the highest level of the year. The price declined after June to $73.48 in October then advanced to $76.77 in December, and the upward movement of prices continued

[3] Neal, Paul A., Mercury Poisoning from the Public Health Viewpoint: Am. Jour. Public Health, vol. 28, No. 8, August 1938, pp. 907-915.

[4] Duschak, L. H., and Schuette, C. N., The Metallurgy of Quicksilver: Bureau of Mines Bull. 222, 1925, 173 pp.

in 1939. Demand abroad was better than in this country, consequently the New York and London price differential was lower in 1938 than at any time since 1931, when the United States had an excess of production and exported relatively large quantities of metal. The London price fell only 4 percent compared with a 16-percent decline in New York, thus the differential between New York and London prices was only $8.55 in 1938 compared with $20.53 in 1937. The domestic tariff is $19 a flask.

Average monthly prices per flask (76 pounds) of mercury at New York and London and excess of New York price over London price, 1936–38

Month	1936			1937			1938		
	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	$76.77	$64.02	$12.75	$90.25	$69.52	$20.73	$79.24	$64.31	$14.93
February	77.00	63.01	13.99	91.00	69.98	21.02	76.46	64.54	11.92
March	77.00	64.10	12.90	91.78	70.43	21.35	72.44	63.61	8.83
April	76.73	62.40	14.33	92.00	70.61	21.39	71.02	63.07	7.95
May	74.94	61.81	13.13	95.52	75.89	19.63	74.64	65.63	9.01
June	74.19	62.05	12.14	96.65	75.29	21.36	80.73	68.98	11.75
July	73.42	60.96	12.46	93.90	73.41	20.49	76.86	68.58	8.28
August	73.92	61.57	12.35	91.42	67.70	23.72	75.50	67.90	7.60
September	85.28	64.97	20.31	89.02	67.30	21.72	74.42	66.83	7.59
October	89.24	67.23	22.01	86.14	65.61	20.53	73.48	68.90	4.58
November	90.25	69.65	20.60	83.44	65.01	18.43	74.07	68.81	5.26
December	90.25	69.94	20.31	81.04	65.02	16.02	76.77	70.99	5.78
Average	79.92	64.33	15.59	90.18	69.65	20.53	75.47	66.92	8.55

[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.

CONSUMPTION AND USES

Figures covering the available supply of mercury in 1938 indicate that consumption declined sharply from 1937. Although the rate of consumption was lower in 1938, the use of metal obtained from foreign ores, which are not covered by import statistics or domestic production figures, and possible withdrawals from consumers' stocks resulted in actual consumption being considerably above apparent consumption.

The General Electric Co. reports that a new mercury boiler, which will require 100,000 pounds of metal, will be installed in 1939. It estimates that an additional 4,000 to 5,000 pounds of mercury will be required in 1939, principally for mercury lamps and mercury switches.

Lignasan is a product made by du Pont for use in controlling sap stain in the timber industry, in which the active ingredient is 6.25 percent ethyl mercury chloride, equivalent to slightly less than 5 percent metallic mercury. A new Lignasan, claimed to be superior to the older type, contains 6.25 percent ethyl mercury phosphate.

During 1938 the completion of fluorescent lamps with 3 to 10 times the efficiency of Mazda lamps was announced. In these units an arc is maintained between electrodes in the ends of evacuated glass tubes. Mercury vapor sustains the arc.

A new wall-type mercury switch may consume a fair quantity of metal.

A submersible turbine pump has been developed in which the water is sealed out at the top by mercury in a rotating cup attached to the motor shaft.

Two new fungicides were announced early in 1939 by Mer-Q-Ree, Inc.—Mer-Q-Ree for use in exterior paints and R888 (mercury fill) for use in interior paints. Both are furnished in semiliquid form and are described as easily miscible.

An artificial minnow that contains a small quantity of mercury to make it wiggle in a lifelike manner as it is trolled through the water is being manufactured by the Mercury Bait Co. of Cleveland.

REVIEW BY STATES

Output of mercury in the United States in 1938 increased 9 percent over the relatively stationery production in 1937 and 1936. The gain in 1938 was due mainly to larger production by the New Idria, Mount Diablo, Mirabel, Oat Hill, and Great Western mines in California and by the Bonanza mine in Oregon, which more than offset the closing of the Oceanic mine in midyear, the idleness of the Big Bend mine, and reduced activity at other Texas properties, as well as lower production at some of the properties that remained active most or all of 1938. California's output rose from 9,743 flasks in 1937 to 12,277 in 1938, and its share of the total jumped from 59 percent to 68 percent. Oregon, the second largest producing State, increased its output from 4,264 to 4,610 flasks, while its share of the country's total was 26 percent, as in 1937. Production in Nevada remained unimportant, but activity in the Bottle Creek district was claimed to point the way toward greater production in the future. Alaska also produced some metal in 1938 and anticipated expansion. Output in Texas declined in 1938. Arkansas failed to increase production in 1938, and Washington's output remained insignificant. The principal producing mines in 1938 were as follows: 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 and Oceanic mines; and Sonoma County, Cloverdale mine. Oregon: Douglas County, Bonanza mine; Jefferson County, Horse Heaven mine; Lane County, Black Butte mine; and Malheur County, Opalite mine. Texas: Brewster County, Chicos and Rainbow mines. These 15 mines produced 90 percent of the country's total compared with 86 percent by the 15 principal mines in 1937.

Mercury produced in the United States, 1937–38

Year and State	Producing mines	Flasks of 76 pounds	Value [1]	Year and State	Producing mines	Flasks of 76 pounds	Value [1]
1937				1938			
Arizona	3	37	$3,337	California	52	12,277	$926,545
California	54	9,743	878,624	Nevada	17	336	25,358
Nevada	20	198	17,855	Oregon	13	4,610	347,917
Oregon	14	4,264	384,527	Alaska, Arkansas, Texas, and Washington	9	768	57,961
Arkansas, Texas, and Washington	10	2,266	204,348		91	17,991	1,357,781
	101	16,508	1,488,691				

[1] Value calculated at average price for quicksilver at New York.

Alaska.—Arthur J. Skidmore began production of mercury at the Parks Cinnabar mine in the Kuskokwim district in 1938 with an output of 8 flasks. A home-made retort is being used at this property.

Arizona.—No production of mercury was reported for Arizona in 1938. At the Ord group work was confined to remodeling the rotary furnace and development underground.

Arkansas.—S. E. Evans produced mercury at the Caddo mine in Clark County in 1938. This property and the mine of the Southwestern Quicksilver Co., in Pike County, were the principal producers in Arkansas. The mine of the Mid-Continent Quicksilver Co., also in Pike County, was operated under bankruptcy in 1938, part of the time by a lessee and part of the time by a trustee. Increased activity is expected at this mine in 1939. It is reported that the Big Six Mining Co. plans to build a rotary furnace at its mine in 1939.

Mercury deposits in southwestern Arkansas have been described by Reed and Wells.[5]

California.—As usual, California was the principal mercury-producing State in 1938. The production of 12,277 flasks in 1938 was 26 percent larger than in 1937, despite the midyear closing of the Oceanic mine, one of the largest producers in California. The increase was due largely to greater production at the New Idria mine. Contra Costa, Fresno, Inyo, Kern, Kings, Lake, Monterey, Napa, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Siskiyou, Solano, Sonoma, Trinity, and Yolo Counties contributed to California's output. The New Idria mine in San Benito County, operated by the New Idria Quicksilver Mining Co., was the largest producer. Other large producers were the Mount Diablo mine in Contra Costa County; Sulphur Bank, Mirabel, and Great Western mines in Lake County; Oat Hill mine in Napa County; Klau and Oceanic mines in San Luis Obispo County; New Almaden mine and dumps in Santa Clara County; and Cloverdale mine in Sonoma County.

The Bradley Mining Co. operated its Mount Diablo mine in Contra Costa County throughout the year and made an important production of quicksilver.

The Archer and Mercy mines in Fresno County were operated in 1938. Production at both properties was made in retorts. It was reported that O. R. Rodgers plans to install a concentrating plant at the Mercy mine.

Mercury was produced at the Coso mine, Inyo County, in 1938 by A. W. Legge. A 20-ton Nichols-Herreshoff furnace was installed at this property during the year.

The Walabu Mining Co. produced 31 flasks of mercury at the Cudde, back mine, Kern County, in a Gould rotary furnace.

Bert Harvey produced metal at the Kings mine, Kings County, in 1938.

The principal producers in Lake County were the Sulphur Bank and Great Western mines of the Bradley Mining Co. and the Mirabel mine of the Mirabel Quicksilver Co. Three other properties were producing in 1938. Lake County produced 3,715 flasks of mercury in 1938, the second most important output in California.

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[5] Reed, J. C., and Wells, F. G., Geology and Ore Deposits of the Southwestern Arkansas Quicksilver District: Geol. Survey Bull. 886-C, 1938, pp. 15-90.

Operations were continued for 6 months of the year and mercury was produced at the Franciscan mine, Monterey County, formerly known as the Patriquin mine.

Six properties in Napa County produced mercury in 1938. The principal mine was the Oat Hill, which was active from January 1 to September 1 and recovered 487 flasks of metal in a Gould rotary furnace. The mine was reopened in January 1939. Other producers were the Aetna, Manhattan, Oat Hill Extension, La Joya, and James Creek mines.

The principal mercury-producing mine in the United States, as well as in California, was the New Idria, San Benito County. Two of the four Gould rotary furnaces at the property were operated during the year, treating newly mined ore and material from the old Scott furnace and coarse-ore furnace dumps. About 200,000 tons of dump material averaging about 3½ pounds of mercury to the ton are still available at the mine. Trade reports indicated that 125 men were employed at the property in the final quarter of the year. A labor strike at the mine which lasted 2 months was settled in January 1939. Eight other properties, chief among which was the Aurora, produced mercury in San Benito County in 1938.

San Luis Obispo County produced 1,111 flasks of mercury in 1938. The principal producers were the Oceanic and Klau mines. At the Oceanic mine 11,334 tons of ore were treated in a 75-ton rotary furnace and 597 flasks of metal produced. This mine was closed in midyear, and negotiations for its sale apparently did not result in a change in ownership. The Klau mine was reported to be operating with a skeleton crew at the end of 1938. There were five other producers in the county in 1938.

The Red Rock mine of the Santa Ynez Mercury Corporation, Ltd., in Santa Barbara County, a large producer of mercury in 1937, also produced in 1938, but the company went into receivership in the first half of the year, and the mine was idle thereafter. P. B. de Mandel reported that the Cal-Mer (Lion's Den) mine was closed because reserves of ore were exhausted.

Mercury was produced from newly mined ore and from surface dumps at the New Almaden and Guadalupe mines in Santa Clara County. Metal was also produced at the North Almaden mine.

A new screening concentrating plant with a capacity of 420 to 450 tons a day was completed and put into operation at the Cloverdale mine, Sonoma County, in 1938. Geo. H. Burr, Jr., president and general manager of the producing company, estimated in October that 250,000 tons of 1-percent ore were in sight. After a substantial production the mine was closed late in the year owing to financial difficulties. Trade reports indicated that a new Wyatt furnace was completed and placed in service at the Contact mine in 1938. Five other properties produced mercury in Sonoma County.

Idaho.—Press reports indicate that a large deposit of cinnabar ore was discovered recently 16 miles from Weiser and was leased for a 20-year period to L. K. Requa.

Montana.—A cinnabar vein is reported in the press to have been discovered by the Western Mines Corporation at its property in Fergus County.

Nevada.—Mercury was produced in Esmeralda, Humboldt, Mineral, Nye, and Pershing Counties in 1938, but the total output of the State was only 336 flasks. Considerable prospecting and development work were reported around Fallon and in the Bottle Creek district, Humboldt County. Several properties in Humboldt County produced metal, and press reports claimed that increased production could be expected from this area. Retorts were constructed at two or more mines in Humboldt County during the year, and other retorts were reported to be under construction. Frequent rumors that the Castle Peak mine was about to be optioned to one or another company and reopened failed to result in any production at this Storey County mine. Early in 1939, however, it was reported that the American Quicksilver Corporation had optioned the property and soon would start active operations.

Oregon.—Production of quicksilver in Oregon totaled 4,610 flasks in 1938, an increase of 8 percent over 1937. The increase was due mainly to greater activity at the Bonanza mine, Douglas County, where H. C. Wilmot is manager. The recovery of 1,183 flasks of metal from 14,914 tons of ore placed this mine among the leading mercury-producing properties in the country. The other principal producers in Oregon in 1938 were the Horse Heaven mine, Jefferson County, and the Black Butte mine, Lane County. Production was also made in Clackamas, Crook, and Malheur Counties.

Five producing properties in Crook County failed to make a large contribution to the country's total.

The Horse Heaven mine, Jefferson County, was the largest mercury producer in Oregon in 1938 and the second largest in the country. Two other properties in this county produced the metal.

The Quicksilver Syndicate, operating the Black Butte mine, Lane County, treated 19,701 tons of ore in two 75-ton rotary furnaces and recovered 803 flasks of mercury in 1938.

The Opalite mine of the Bradley Mining Co., Malheur County, leased for part of the year, produced in 1938. The furnace building at the mine was destroyed by fire in December 1938.

FOREIGN TRADE [6]

Imports of mercury for consumption in the United States in 1938 were only 12 percent of the relatively constant rates for 1936 and 1937. Of the 1937 total, more than one-half arrived in the first 4 months. Importations virtually ceased in the closing months of 1937, and this lack of activity was characteristic of most of 1938. Of the 2,362 flasks received, 1,111 flasks were credited to Italy and 1,251 flasks to Spain. Metal known to have been exported from Mexico to this country must have been reexported abroad, because none is credited to Mexico in import statistics. Antimony-mercury concentrates imported from Mexico are treated in this country, and the metal produced therefrom, aggregating more than 2,600 flasks in 1938, is consumed here. Statistics covering this movement are not shown separately in foreign-trade records.

[6] 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 imported into the United States, 1934–38, by countries

Country	1934		1935		1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Hong Kong							5	$5		
Italy	49, 285	$33, 339	68, 705	$30, 735	491, 714	$385, 236	747, 266	649, 406	84, 454	$50, 434
Mexico	188, 494	120, 914	4, 182	2, 975	26, 393	21, 708	116, 497	104, 730		
Spain	536, 025	326, 635	521, 017	347, 806	774, 785	544. 072	535, 156	440, 804	95, 068	82, 176
Sweden	760	600								
United Kingdom					81, 760	66, 801	38, 788	33, 046		
	774, 564	481, 488	593, 904	381, 516	1, 374, 652	1, 017, 817	1, 437, 712	1, 227, 991	179, 522	132, 610

The threatened invasion by foreign producers of the domestic market for mercury compounds appears to have been unfounded, as importations under this class decreased.

Mercury compounds imported for consumption in the United States, 1937–38

Compound	1937		1938	
	Pounds	Value	Pounds	Value
Chloride (mercuric) (corrosive sublimate)	35, 524	$16, 781		
Chloride (mercurous) (calomel)	22, 618	14, 852	265	$358
Mercury preparations (not specifically provided for)	15, 737	9, 252	11, 786	7, 604
Oxide (red precipitate)	4, 405	2, 740	1, 011	815
Vermilion reds (containing quicksilver)	52, 708	49, 137	33, 884	30, 243
		92, 762		39, 020

Exports of mercury totaled 713 flasks valued at $50,184 in 1938 compared with 454 flasks valued at $37,165 in 1937. Of the 1938 total, 160 flasks went to South America, 405 flasks to the United Kingdom, and the remainder in small lots to nearly two dozen countries.

WORLD PRODUCTION

The following table shows world production of mercury, by countries, from 1934 to 1938.

World production of mercury, 1934–38, by countries

[Compiled by R. B. Miller]

[1 metric ton=29.008 flasks of 76 pounds]

Country	1934		1935		1936		1937		1938	
	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons	Flasks	Metric tons
Algeria					102	3. 5	114	3. 9	130	4. 5
Australia: Queensland	3	0. 1	17	0. 6	78	2. 7	9	. 3	(1)	(1)
Austria			12	. 4	3	. 1	134	4. 6	(1)	(1)
Bolivia [2]	557	19. 2	250	8. 6	224	7. 7	16	. 6		
Canada									10	. 3
China [2]	2, 950	101. 7	1, 313	45. 3	2, 460	84. 8	1, 736	59. 8	65	2. 2
Chosen			4	. 1	2	. 1	2	. 1	(1)	(1)
Czechoslovakia	763	26. 3	2, 004	69. 1	1, 876	64. 7	275	94. 8	(1)	(1)
Germany			116	4. 0	1, 093	37. 7	[3] 1, 741	[3] 60. 0	(1)	(1)
Italy	12, 804	441. 4	28, 191	971. 8	42. 732	1, 473. 1	66, 963	2, 308. 4	66, 719	2, 300. 0
Japan	196	6. 8	148	5. 1	429	14. 8	580	20. 0	(1)	(1)
Mexico	4, 580	157. 9	6, 277	216. 4	5, 307	183. 0	4, 936	170. 2	8, 519	293. 7
New Zealand	49	1. 7	7	. 3			18	. 6	(1)	(1)
Rumania	2	. 1	1	. 1	2	. 1	(1)	(1)	(1)	(1)
Spain	31, 799	1, 096. 2	35, 559	1, 225. 8	43, 424	[2] 1, 497. 0	28, 357	[2] 977. 5	40, 000	[2] 1, 378. 9
Tunisia			25	. 8	72	2. 5	25	. 9	201	6. 9
Turkey	41	1. 4	25	. 9	836	28. 8	484	16. 9	(1)	(1)
U. S. S. R	7, 750	[4] 267. 6	8, 700	[4] 300. 0	8, 700	[4] 300. 0	8, 700	[4] 300. 0	(1)	(1)
United States	15, 445	532. 4	17, 518	603. 9	16, [illegible]69	571. 2	16, 508	569. 1	17, 991	620. 2
	76, 939	2, 652. 8	100, 167	3, 453. 2	123, [illegible]09	4, 271. 8	(1)	(1)	(1)	(1)

[1] Data not yet available.
[2] Exports.
[3] Estimated.
[4] Imperial Institute, Loudon and Metallgesellschaft.

Algeria.—The Societe Nouvelle des Mines de Ras-el-ma has been registered with a capital of 510,000 francs to work the Ras-el-ma quicksilver deposits, the only quicksilver deposits of note in Algeria.

Canada.—Nelson P. Meeks, American Vice Consul, reported in midyear of 1938 that although no mercury had been produced on a commercial scale in British Columbia a group of Montreal and Vancouver men were developing a property on Mud Creek in Bridge River Valley. He said that recent press reports indicated that additional deposits of this mineral had been found 15 miles north of the operations on Mud Creek, following erosions and slides that bared the surface of a slab of rock 50 feet wide and many feet deep. The new discovery has lower average values than that at Mud Creek, but tonnage possibilities were believed to exist.

A 10-ton testing furnace began recovery of the metal in the late months of the year.

Czechoslovakia.—An article in the Mining World & Engineering Record of February 25, 1939, stated that a French company recently produced about 143,300 pounds of quicksilver in the mines at Mernik and Teplou.

Italy.—Italy continued to be the principal world source of mercury in 1938, and output was maintained at virtually the record level of 1937. Production totaled 66,719 flasks in 1938 compared with 66,963 flasks in 1937 and an average of 39,800 flasks for the 10-year period, 1927–36. Demand for Italian metal fell in 1938, however, and exports were only 55,327 flasks compared with 67,075 flasks in 1937. Despite this drop, exports in 1938 were considerably above the 41,357 flasks and 35,851 flasks shipped in 1936 and 1935, respectively, before the civil war in Spain interfered with the normal flow of metal from that source. Stocks of metal in Italy were reported to be low at the end of 1937, but they were substantially increased in 1938 by the excess of production over exports.

Mercury produced in Italy in 1936, by Provinces

Province	Ore mined						Metal produced				
	Number of mines	Number of workmen	Metric tons	Tenor (percent)	Value [1]	Tons per man	Number of plants	Number of workmen	Flasks (76 pounds)	Value [1]	Flasks per man
Cagliari (Iglesias) [2]	------	------	------	------	------	------	(2)	(2)	30	$1,907	(3)
Gorizia (Trieste)	1	541	43,510	.785	$399,426	80	1	83	8,936	578,840	108
Grosseto (Firenze)	1	189	7,270	.50	37,259	38	2	21	1,057	69,064	50
Siena (Firenze)	3	626	90,534	1.25	1,768,086	145	3	263	32,709	2,137,665	124
.	5	1,356	141,314	.845	2,204,771	104	6	367	42,732	2,787,476	[3] 116

[1] Lire converted to dollars at the average annual rate of exchange, as published by the U. S. Federal Reserve Board.

[2] Product recovered in the plant of the Società di Monteponi from condensation of mercury vapor obtained in lead smelting.

[3] Exclusive of output at Cagliari.

The most productive deposits in Italy are those of the Month Amiata district in Tuscany, Province of Siena; next in importance are the Government-owned Idria mines, in the foothills of the Julian Alps, Province of Gorizia. According to the Metal Bulletin of November 15, 1938, other producers are the properties of the S. A. Mineraria Argus at Abetina in Tuscany, Province of Siena, and Stabilimento

Minerario del Siele, also in Tuscany. The Amalgamated Merchants, Ltd., of London, represents "Mercurio Italiano" and has accounted for about 88 percent of Italian mercury sales. The Argus mine is the principal producer not included in Mercurio Italiano, and the 3,000 to 5,000 flasks ordinarily recovered at this property are sold in the open market.

Of the mercury exported by Italy in 1938, 59 percent went to Germany, 12 percent to Japan, and 6 percent to France. Exports to Germany increased from 24,000 flasks in 1937 to 32,600 in 1938 and those to Japan from 4,000 to 6,600 flasks.

According to Sheridan Talbott, American consul, Leghorn, Italy, workers at the Monte Amiata mine received the following hourly wages in 1938.

Hourly wage rates at the Monte Amiata mine in 1938, by classes of workers

	Lire
Inside workers:	
Miners	2.354
Assistant miners	2.259
Laborers, unskilled	2.165
Outside workers:	
Firemen	1.97
Laborers, unskilled	1.73
Mechanics, locksmiths, carpenters	2.14

The workday for inside laborers is 7 hours, while that for the remainder is 8 hours. Rates for piecework are 33 percent higher for miners, 31 percent for assistant miners, 35 percent for unskilled laborers working inside the mines, and 30 percent for all others. Overtime rates are 15 percent above normal rates for all categories. The workers are paid for 4 holidays and for a 6-day vacation. Family allowances range from 3.60 lire a week for one child to 6 lire each for four or more children. The family allowances are paid until each child is 14 years old. There is a wage tax of 4 percent on net wages exceeding 180 lire a week, a social-insurance contribution of 2.05 lire a week, and some smaller deductions. The wages noted above were fixed by the collective contract of January 1, 1934, but have been increased in accordance with the decisions promulgated by the Italian Government for all classes of laborers. Furthermore, they were increased 10 percent in 1937 by the company itself. The collective contract was up for renewal in 1938, with prospects for slight wage increases. At the time the consular report was prepared, July 27, 1938, the lire was valued at $0.0526.

Japan.—Information covering output and imports of mercury into Japan in 1937 and 1938 is not available. That the situation regarding supplies of quicksilver is serious is attested by the strict control over commercial transactions in this metal announced during the year by the Ministry of Commerce and Industry to the prefectural governors. Reports were current early in the year that there was a brisk demand for mercury for the recovery of gold from poor ores and that mercury was also in demand for the electrolytic reduction of caustic soda.

Mexico.—Production of mercury in Mexico increased from 4,936 flasks in 1937 to 8,519 in 1938.

The Bureau of Mines is indebted to Vice Consul Norman L. Christianson for the following summary of operations at the Huitzuco mine.

The Huitzuco quicksilver mine, located in north-central Guerrero, is operated at present by Explotadora de Mercurio de Huitzuco, S. A., organized in 1930 and believed to be controlled entirely by Mexican capital. A flotation mill of 160 tons of ore a day capacity is in operation. In the latter part of 1938 the mill was producing daily from 3 to 4 tons of concentrates with an average content of 7 to 11 percent mercury and 25 to 30 percent antimony. The mill was designed by Penhoel-Menardi Engineering Co., Ltd., of Los Angeles. In 1937, 515 flasks of mercury, and from January to March, 1938, 11 flasks of metal were produced experimentally in a Johnson-McKay retort. Refining of concentrates in Mexico has been discontinued, temporarily at least, and all concentrates are now being shipped to the United States for treatment. By shipping the concentrates to the United States advantages are gained in respect to both quicksilver and antimony, for imports of both of these metals are subject to duties, whereas imports of ores and concentrates of quicksilver and antimony are permitted to enter the country duty free. The concentrates are shipped by truck to Iguala, on the Mexico City-Acapulco highway, about 124 miles from the capital and 15 miles from the mine. From Iguala they are sent by rail to Mexico City and thence by rail to Los Angeles, via El Paso, Texas. In 1937, 30,184 short tons of ore, with an average content of 0.315 percent mercury and 1.25 percent antimony, were produced and from January 1 to November 30, 1938, 46,822 tons, containing 0.24 percent mercury and 0.96 percent antimony were produced. Concentrates totaling 552 tons, shipped to the United States in 1937, contained the equivalent of 1,205 flasks of mercury, and those shipped from January 1 to December 19, 1938, contained the equivalent of 2,605 flasks of metal. The reduction of the concentrates has been described by Menardi.[7] Exports of mercury from Mexico for the first 10 months of 1938 totaled 6,908 flasks compared with 4,610 flasks in all of 1937.

Spain.—Official statistics covering production and exports of mercury from Spain are not available. However, Roura & Forgas, selling agents for Almaden metál, report that exports totaled 43,424 flasks in 1936, 28,357 in 1937, and 31,060 for 10 months of 1938. Their estimate for all of 1938 was 40,000 flasks. Production during the 3-year period, 1936–38, was below exports, and large quantities of metal were shipped from stocks. There were no stocks of mercury at Spanish ports at the end of 1937 and only small stocks at the Almaden mine.

The Almaden quicksilver industry is discussed at length in Deutsche Bergwerks Zeitung of March 29, 1939, and an abstract of the article appears in the Mining Journal of London.[8]

Information on annual wage rates paid at the Almaden mine in 1938 were reported by American Vice Consul Woodruff Wallner, Valencia, Spain, to be as follows:

[7] Menardi, H. B., Reduction of Livingstonite Concentrate: Am. Inst. Min. and Met. Eng., Metals Technol., vol. 6, No. 2, February 1939, 8 pp.
[8] Mining Journal, London, The Almaden Quicksilver Industry: Apr. 8, 1939, p. 377.

Annual wage rates at the Almaden mine in 1938, by classes of workers

Class of worker	Pesetas	Equivalent at 20 to $1	Class of worker	Pesetas	Equivalent at 20 to $1
Inside workers:			Outside workers—Continued.		
Quarry drillers, master masons, first-class firemen, and shorers	4,512.00	$225.60	Workshop helpers, warehousemen, shipping-department helpers, messengers, gardeners, guards at Almadenejos, and hospital doorkeeper	3,120.00	$156.00
Watchmen and second-class shaft diggers	4,800.00	240.00	Laborers in tool deposits, track workmen, pit guards, and lime-pit brigade	3,360.00	168.00
Track foremen, dumpcart men and shale laborers, masons' helpers, second-class shorers, chute men, mechanics, and second-class firemen	4,032.00	201.60	Inspector in charge of outside work and inspector in charge of works and repairs	4,800.00	240.00
Various shale laborers, shaft carpenters, and mechanics' helpers	3,600.00	180.00	Inspectors	3,660.00	183.00
Mine watchmen	5,400.00	270.00	Women for cleaning	2,160.00	108.00
First-class miners	4,980.00	240.00	Woman in charge of rest house, dispensary and school garden porters	2,555.00	127.75
Outside workers:			Hospital nurses (male)	2,340.00	117.00
Engine drivers at San Teodora and San Aquilino, first-class power station electricians, first-class machine-shop and quarry foremen	4,512.00	225.60	Nurses (female), cooks, washerwoman, and hospital janitress	1,800.00	90.00
Drivers of compressors and locomotives, power-station helpers, drivers of mechanical vehicles, and second-class machine-shop men	4,302.00	201.60	"Buitrones" works:		
Ventilator mechanics	3,912.50	195.62	Spirek and works foremen	4,800.00	240.00
Smelting mechanics, lime-pit foremen, pit foremen, and timekeepers	3,780.00	189.00	First-class lime workers and Spirek conveyor-belt foreman	4,512.00	225.60
Oilers, workshop apprentices, errand boys, and messengers	2,400.00	120.00	Second-class lime workers	4,032.00	201.60
Heating installation and workshop foremen	4,932.00	246.60	Quicksilver weighers	4,632.00	231.60
Third-class workshop men and scale men	3,600.00	180.00	Workmen on the quicksilver tubes	3,900.00	195.00
			Quicksilver box cleaners	3,780.00	189.00
			Master masons	4,272.00	213.60
			Master masons' assistants	3,960.00	198.00
			Master masons' laborers	3,600.00	180.00
			Pit laborers	3,360.00	168.00

United Kingdom.—Mercury was shipped directly to foreign countries from Spain in 1936, but since the beginning of 1937 all available metal has been exported to London for distribution. As a consequence, figures for imports and reexports of quicksilver for the United Kingdom jumped sharply in 1937 and 1938. Imports were 44,317 flasks in 1938, 49,894 in 1937, and 22,468 in 1936, and reexports during those years were 15,535, 28,127, and 5,571 flasks, respectively. From these data it is evident that the United Kingdom, one of the largest mercury-consuming countries in the world, consumed more metal in 1938 than in 1937. Roura & Forgas, selling agents for the Almaden mine in Spain and Amalgamated Merchants, Ltd., selling agents for most of the Italian metal, have combined offices in London. At the end of 1937 Roura & Forgas were reported to have 22,000 flasks of metal on hand in London. As inventories in Italy and at Spanish ports were low or nonexistent, this metal represented the principal stocks of quicksilver for sale at that time.

TIN [1]

By E. W. PEHRSON AND JOHN B. UMHAU

SUMMARY OUTLINE

The prosperous conditions prevailing in the world tin industry during 1937 were sharply reversed in 1938. A substantial decline in demand for tin products in the United States resulting from the industrial recession caused an abrupt curtailment in the consumption of pig tin. This situation was aggravated by the liquidation of stocks of semimanufactured goods (acquired in 1937 in anticipation of price increases), particularly tin plate, production of which declined 40 percent from the all-time high established in 1937, although the demand for tin cans declined only 10 percent, judged from the trend in food packing. Domestic use of tin in solder, babbitt, bronze, and collapsible tubes and foil showed major declines, reflecting the narrower market for automobiles and other consumer goods. Consequently, imports of pig tin, were 44 percent below the record established in 1937. New York prices moved downward during the first part of the year and early in May reached the lowest level since May 1933. Visible stocks of tin in the United States decreased during 1938, and consumers' stocks increased little, if at all; total stocks dropped about 15 percent.

Salient statistics for tin in the United States, 1925–29 (average) and 1934–38

	1925–29 (average)	1934	1935	1936	1937	1938
Production—						
From domestic mines ... long tons	24	8.2	44.5	101.0	168.4	[1] 109
From secondary sources ... do	30,600	22,200	24,900	25,000	27,100	21,080
Imports for consumption (metal) ... do	78,009	39,986	64,258	76,029	88,115	49,699
Exports (domestic and foreign) [2] ... do	1,740	[2] 1,216	[2] 2,292	[2] 386	[2] 313	[2] 205
Monthly price of Straits tin at New York:						
Highest ... cents per pound	70.67	55.60	52.29	51.85	62.71	46.23
Lowest ... do	39.79	50.87	46.91	42.22	42.85	36.84
Average ... do	56.64	52.16	50.39	46.42	54.24	42.26
World production ... long tons	163,000	120,400	135,300	179,300	210,200	147,500
Ratio United States imports to world production ... percent	48	33	47	42	42	34

[1] Subject to revision.
[2] Figures for 1934–38 cover foreign only; domestic not separately recorded.

[1] The long ton is used throughout this report.

Outside the United States apparent consumption was approximately 10 percent less in 1938 than in 1937. In contrast to Germany, Japan, and Italy, which took more tin in 1938 than in the previous year, the United Kingdom, France, and the U. S. S. R. took less. Total world visible stocks increased 13 percent and at the end of 1938 were higher than at the end of any year since 1932.

To meet the declining demand, the International Tin Committee made successive reductions in permissible export quotas from 110 percent of standard tonnages in the last quarter of 1937 to 70 percent in the first quarter of 1938, 55 percent in the second quarter, and 35 percent in the last half of the year. World production decreased 30 percent compared with 1937. Countries signatory to the International Tin Control Scheme bore the major part of the reduction, their output having declined 33 percent whereas that of the nonsignatory countries decreased only 10 percent. The latter group produced 19 percent of the total output in 1938 and 15 percent in 1937.

The Buffer Stock Scheme proposed in 1937 was adopted officially in June 1938, and during the latter half of the year an additional production quota of 10 percent was allowed for stock accumulations. The purpose of the pool is said to be stabilization of tin prices between £200 and £230 per long ton (43.5 to 50.0 cents per pound).

Government action affecting tin.—The trade agreement with the United Kingdom signed November 17, 1938, bound imports of tin into the United States on the free list provided:

> That the Government of the United States of America reserves the right to withdraw the concession hereby granted if at any time after January 1, 1939, an export tax is charged in Nigeria on tin ore and concentrates exported to the United States of America other than or different from any export tax which may at the same time be charged on tin ore and concentrates exported to any part of the British Empire.

Effective January 1, 1939, the Nigerian Government reduced the export tax on tin-ore shipments to the United States in accordance with this agreement.

The tariff acts since 1922 have provided duties of 4 cents per pound on tin imported into the United States as ore and 6 cents on tin imported as metal whenever domestic production of tin amounted to 1,500 tons per annum. As there was little hope that domestic output would reach that magnitude, the chance of the tariff ever becoming effective has been extremely remote. Thus from the standpoint of the United Kingdom, this concession by the United States has little practical significance. The same may be said of the British concession on Nigerian ore. It has been stated frequently that creation of a smelting industry in the United States, based primarily on the impure tin concentrates produced in Bolivia, would be facilitated if they were mixed with the purer concentrates produced in British and Dutch possessions. Movement of these ores to the United States was precluded in the past by discriminatory export taxes. This obstacle has now been removed as regards Nigeria, and presumably anyone wishing to establish a smelting industry in the United States should be free to compete with the British smelters for clean Nigerian ores. However, in view of the existing commercial relationships between the principal Nigerian producers and the British smelting interests it is believed that despite removal of the discriminating export duty no substantial quantity of ore will be diverted to the United States.

The appropriation bill for the Navy Department for the fiscal year 1938–39 provided $500,000 for the purchase of strategic commodities, most of which was spent for tin. Larger purchases of tin and other strategic commodities are contemplated in legislation now pending in Congress. S. 572, passed by the Senate on March 31, 1939, provides a total of $40,000,000 for this purpose over a period of 4 years and $500,000 annually for 4 years for an investigation of domestic resources of deficient minerals by the Bureau of Mines and the Geological Survey of the United States Department of the Interior. The bill was also passed by the House of Representatives on April 25, 1939, in an amended form providing $100,000,000 for stock-pile purchases. As of May 29, 1939, the conferees had agreed on the provision of $100,000,000 and the bill was awaiting final congressional approval.

H. R. 5840, passed by the House of Representatives on May 1, 1939, proposes to amend the Faddis-Barbour bill licensing the export of tin-plate scrap 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." Presumably this bill is designed to curtail exports of tin byproducts, such as drosses, which are reported to have increased in recent years. Official quantitative data on this trade are not available.

The McReynolds bill, H. R. 9154 of the Seventy-fifth Congress, was not introduced in the Seventy-sixth Congress. The bill was the outgrowth of the extensive tin investigation conducted by the subcommittee of the House Committee on Foreign Affairs. It provided for the creation of a Board for Strategic Materials to study the supply of tin and other strategic materials in the United States.

The Bureau of Mines conducted concentrating tests on samples of tin ore from Goodwater, Ala.;[2] Majuba Hill, Nev.;[3] and Tinton, S. Dak.[3] Report of Investigations 3404, also published by the Bureau, described the pegmatites at Tinton.[4]

TIN AND NATIONAL DEFENSE

The present intense interest in national defense has focused attention on strategic materials in which the United States is deficient. Tin ranks high among such materials owing to the essential usefulness of the metal industrially, the lack of commercial deposits, and the almost total dependence of this country on relatively few overseas sources of supply. Under normal conditions the United States consumes more than 75,000 tons of tin annually, or approximately 45 percent of the total world output. Domestic production never has exceeded 170 tons per annum; thus requirements have been met by imported metal. During the past 5 years 81 percent of the foreign purchases was obtained from Asia (69 percent from British Malaya), 18 percent from Europe, and 1 percent elsewhere.

In time of peace this dependence on foreign sources presents no serious problem; adequate supplies usually have been available, and prices seldom have been exorbitant. In the event of war, however,

[2] Ore-Testing Section, Progress Reports—Metallurgical Division 22. Ore-Testing Studies, 1936–37: Bureau of Mines Rept. of Investigations 3370, 1938, p. 111.

[3] Metallurgical Division, Progress Reports—Metallurgical Division 27. Ore-Testing Studies, 1937–38: Bureau of Mines Rept. of Investigations 3425, 1938, pp. 86–87.

[4] Hess, Frank L., and Bryan, Barnabas, Jr., The Pegmatites at Tinton, S. Dak.: Bureau of Mines Rept. of Investigations 3404, 1938, 19 pp.

it constitutes a serious threat to national security because foreign sources of supply are vulnerable to blockade by hostile fleets. Deprived of tin, the industrial power and hence the military effectiveness of the United States would be impaired seriously.

During the World War the procurement of deficient strategic materials, including tin, presented many grave problems, and on several occasions severe shortages were averted only by narrow margins. Despite these experiences the United States has done little toward improving its strategic position in tin and at present the problem is more acute than ever, owing to the large increase in consumption since 1918. However, the recent intense interest in national defense arising from the critical international situation has prompted exhaustive consideration of the subject of deficient raw materials by Congress, and as this is written there is every indication that constructive action soon will be taken.

Failure hitherto to adopt constructive measures to end this perilous condition has not been due to lack of proper appreciation of the problem or lack of a simple and sound method for solving it. In 1921 the War Department requested several distinguished tin experts to study the situation. Their report [5] clearly demonstrated the inadequacy of domestic deposits and the hopeless outlook for self-sufficiency in the United States. In 1934 the Planning Committee for Mineral Policy appointed by the President recommended the purchase of a stock pile of tin as the only safe way of guaranteeing adequate supplies in a war emergency. The long delay in facing the realities of the strategic mineral problem may be ascribed primarily to the fact that the American public is not military-minded; therefore there was little incentive for political leaders to stir up interest on this subject among voters whose natural apathy was increased by the prosperity of the twenties and the depression of the thirties. Moreover, a few always have claimed that the tin problem could be solved by proper encouragement of domestic production, by the establishment of a smelting industry based on imported ore, or by the use of substitutes. Obviously the development of domestic industries has a more popular appeal than the purchase of foreign products although, as will be shown, the hope of obtaining national security thereby is indeed remote.

Domestic resources.—In a recent (February 28, 1939) study entitled "Report upon Certain Deficient Strategic Minerals," prepared by the staffs of the Geological Survey and the Bureau of Mines, United States Department of the Interior, potential production from domestic tin deposits was summarized as follows:

Sources.—Although tin minerals have been recognized widely in lode deposits in the United States, the principal source of production has been a few placer deposits, largely in a small area in Alaska. Specimens of tin minerals have been found in many places in the United States, but serious efforts to exploit tin-bearing lodes have been confined to the following districts: One in Virginia; two in South Dakota; one in Texas; one in New Mexico; one in California; one in Nevada; and one in Washington. With one exception, that near Temescal, California, each of these districts has been studied by geologists of the Geological Survey, and reports have been issued.

From the nature of the lode and placer deposits of tin, and the manner by which they have been explored, it is impossible to assign definite figures to the reserves of tin. It is safe to state, however, that they are small.

[5] American Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America, International Control of Minerals: New York, 1925, pp. 115–128.

Production from domestic mines.—The placer tin deposits near York, Seward Peninsula, Alaska, have been known for about 40 years and have yielded a small output almost every year. The total exceeds that of all other domestic districts combined. From what is known concerning the geology of the region, and the extent of tin-bearing gravels, it is clear that the district presents the best opportunity in the United States to recover the most tin for a given expenditure, although it seems that the maximum yield cannot be more than a small part of domestic needs.

A large sum, at least five million dollars, has been expended in four districts in the United States in attempts to develop lode tin deposits. Probably the largest sum, reported to be more than three million dollars, was spent in the Harney Peak region, South Dakota, from 1884 to 1892, in exploration and mining and milling plants. The campaign yielded only 5,000 tons of crude ore containing 0.25 percent tin, in contrast to expected yields of 1.0 to 1.75 percent. Commonly, several tons of tin ore a year are produced as a byproduct in mining other minerals, but it seems very doubtful that this district contains much material that would yield more than 0.25 percent tin or 5 pounds per ton. The most encouraging area in the Black Hills is probably that near Tinton, where considerable work has been done since 1900 and 14,000 tons from one mine yielded about 0.35 percent or 7 pounds of tin per ton. Here a readily accessible reserve of several hundred thousand tons is estimated to contain from 7 to 12 pounds per ton.

The pegmatites of the Kings Mountain district, North and South Carolina, resemble those of the Black Hills and more than $500,000 has been spent since 1887 in attempts to recover tin from several deposits. The largest shipments from a single deposit (Ross Mine) amount to about 130 tons of concentrate, and the total for the district since 1888 is probably less than 500 tons. Estimates of the probable grade of minable material show a wide range depending largely on the assumed limits of the bodies. It has not been proven yet that bodies containing as much as several hundred thousand tons would yield more than 5 pounds of tin per ton. A detailed study of the district by Federal geologists is in progress.

Tin-bearing veins have been known in the Temescal district, Riverside County, California, since 1853 and nearly one million dollars has been spent since 1868 in three campaigns of exploration. As a result of a recent exhaustive study of the area that cost $20,000, it is revealed that there are probably several hundred outcropping veins, mostly 1 to 2 feet wide, which contain from 0.03 to 0.15 percent tin (0.6 to 3 pounds per ton). The only shoot that has justified mining (Cajalco Mine), produced, in 1890–92, 7,000 tons of crude ore that yielded about 150 tons of tin. When the mine was reopened in 1927–29, at a cost of several hundred thousand dollars, no more ore was found and the plant was dismantled.

Cassiterite was found in the Franklin Mountains, Texas, 15 miles north of El Paso, in 1899. From 1907–1910, four veins were extensively explored, mining, milling, and smelting plants erected at a cost of several hundred thousand dollars, and 8 tons of metallic tin, valued at $6,800, were produced. There is no record of the grade of the crude material, but estimates indicate about 1 percent tin across veins as much as 2 feet wide.

During 1890–92 and 1918–19, considerable work was done at a cost of several hundred thousand dollars on some tin-bearing veins within a 500-acre tract on Irish Creek, Rockbridge County, Va. In digging numerous shallow trenches, open-cuts, and tunnels, several thousand tons of crude ore were recovered, which, on milling, yielded less than 100 tons of concentrate. Federal geologists are now engaged in an examination of the deposits.

In addition to the comprehensive campaigns of exploration summarized above, some exploratory work has been done on tin-bearing deposits near Spokane, Wash.: Lander and Pershing Counties, Nev.; Catron County, N. Mex.; and Coosa County, Ala., but no ore has been shipped. Even though this work yields valuable information, most of which is recorded in official reports, it is not yet demonstrated that these districts are likely to contribute an appreciable production even at very high prices for tin.

The production of tin minerals in the United States and Alaska is not only small but seems to bear little relation to the prices offered for tin. Compared with the prices of other strategic metals, that for tin has fluctuated least during the last 30 years. The price was highest during the War, but if prevailing commodity prices are considered, index prices for tin have been higher in several post-War years. Sufficient information seems to be on hand concerning the tin content of the lode deposits of the United States to say that at the maximum index price of post-War years, no tin ore can be produced from them at a profit. At this price, however, Alaskan placer deposits will probably continue to yield a small production for many years.

An estimate of the probable yield of the Alaska placers as well as domestic lodes at higher prices must be largely speculative because many unknown elements enter into consideration. The most dependable information concerning known lode deposits indicates that most of the proven material contains from 0.03 to 0.50 percent tin (0.6 to 10.0 pounds of tin per ton) and that material of higher grade is small in quantity and highly sporadic, both locally and throughout the entire country. The following estimates of production attempt to take into account all that is now recorded concerning the number, distribution, grade of domestic deposits, and the costs that are inherent in existing technique of mining and recovery.

Potential production of tin in the United States at assumed index prices of $0.50 and $1.00 per pound, in long tons

Assumed index price	Potential production		
	Alaskan placers	Domestic lodes	Total
$0.50 per pound:			
First year	150-300	0-10	150-310
Second year	150-300	0-10	150-310
Third year	150-300	0-10	150-310
$1.00 per pound:			
First year	250-500	10-50	260-550
Second year	500-1,000	200-500	700-1,500
Third year	1,000-2,000	500-1,000	1,500-3,000

It should be emphasized again that many speculative elements enter into these estimates and that they indicate only the order of magnitude of what may be expected.

Unless some unforeseen new major discovery is made it is evident that the United States must continue to rely on foreign sources of tin and that encouragement of domestic production offers little hope of providing national security in tin.

Domestic smelting industry.—It has been stated that, from the standpoint of national defense, the establishment of a permanent smelting industry in the United States is advantageous for two reasons. First, it would increase the normal stocks of tin, because the smelters would maintain reserve supplies of ore and finished metal and in addition there would be tin in process of smelting. Second, it would eliminate part of the danger arising from our dependence on foreign smelters, all of which are vulnerable to aerial bombardment. These advantages, however, hardly compare with the security afforded by advance purchase of reserve stock piles as recommended by the President's Committee for Mineral Policy.

Such stocks as would be required to maintain a domestic smelting industry would be relatively small in terms of national requirements. At present, consumer stocks are exceptionally high, yet they are equivalent to only a 3-month supply at a normal rate of consumption. Usually they are adequate for less than 1 month's operation. A smelting industry probably would not add more than an additional 2-month supply, which does not go far in guaranteeing tin requirements for a 2-, 3-, or even 4-year emergency.

Although it is true that smelters could be so situated in the United States as to be relatively safe from aerial attacks they would still have to depend on distant ore-producing centers. Bolivia's peak output in 1929 was equivalent to only 55 percent of the tin consumed in the United States in that year. Assuming that the entire Bolivian production could be smelted domestically, large tonnages of ore would have to be obtained from oversea sources. Moreover, from a strategic point of view the United States would be worse off dependent on ore imports than on metal imports, as the situation is now. The greater weight of ore compared with metal would aggravate the transportation problem, and since the principal weakness of our present tin position lies in the danger of our lines of communication being cut off, any increase in volume of traffic is undesirable.

During the World War extraordinary conditions developed in the tin trade that made it desirable to smelt Bolivian tin ores in the United States. With resumption of normal conditions after the war, the domestic smelting industry could not compete with foreign smelters and was forced to discontinue operations. The record shows that smelting costs were higher in the United States than in the United Kingdom and Germany, principally on account of higher labor costs.[6] It is therefore evident that if a smelting industry is to be created it can be established only by increasing the cost of tin to American consumers. This cannot be justified on the basis of national defense, owing to the questionable benefits of a domestic smelting industry in time of war.

Substitutes and restrictions.—In an emergency during which the tin supply might be cut off the use of tin could be reduced considerably by substitution and restriction, but at a terrific cost in terms of industrial efficiency. The introduction of substitutes always entails delay and confusion and should be avoided as much as possible when industry is being mobilized for war. Peacetime development of substitutes for our deficient raw materials should be encouraged, but their acceptance by industry should be predicated only on the basis of lower costs or better performance. Industry should not be deprived of a metal possessing such useful properties as tin in times of peace merely as a precaution against shortage in a war emergency that can be provided for so simply and so cheaply by accumulation of a reserve stock pile. Large scale substitution for tin in time of war should be considered only as an extreme measure.

Stock piles favored by Army and Navy.—For several years the Army and Navy have been advocating stock piles as the logical solution of the national defense problem arising from our deficiency in certain strategic raw materials. The advantages of this method were summarized ably by Capt. F. A. Daubin, United States Navy, Chief, War Procurement Planning Section, office of Chief of Naval Operations, in his testimony before the House of Representatives, Committee on Military Affairs, in March 1939. Captain Daubin stated:

> The importance to the Navy and the national defense of the acquisition of stock piles of these materials may be stated briefly as follows:
>
> The physical possession of adequate reserves of strategic raw materials would afford the United States important advantages, political and military.
>
> As a neutral—it would make us independent of the favors of belligerents who may control the sources of these materials, thereby making simpler the maintenance of neutrality.
>
> As a belligerent—it would insure a ready supply of materials needed by our industrial facilities to produce an uninterrupted supply of munitions so vital at the outset of war when communications are likely to be temporarily disrupted.
>
> Meanwhile, time would be afforded to develop available domestic sources or to find substitutes.

[6] Mineral Industry, 1923 (p. 671) and Tariff Information, 1921: Hearings on General Tariff Revision before Committee on Ways and Means, House of Representatives, 1921, pt. II, p. 1057.

It would free us from the necessity of providing ships to transport these materials at a time when ships would be at a premium.

It would free our fleet from the necessity of patrolling the sea lanes involved in such transportation.

It would make ineffective raw material sanctions which may be directed against us by other countries.

The principle of accumulating stock piles as insurance against a war emergency was first accepted officially in the Navy Department appropriation bill for the fiscal year 1938, when $3,500,000 was provided for the purchase of strategic raw materials. An additional $500,000 was appropriated for 1939, and $500,000 is included in the bill for 1940, now pending. The Navy has acquired a small reserve supply of tin and other commodities with this money, but the amount on hand is very small in terms of national requirements.

In an address entitled "Strategic Minerals in the United States," presented at the annual convention of the American Zinc Institute in St. Louis in April 1938, Dr. John W. Finch, Director of the Bureau of Mines, proposed the following two-point program for attacking our deficiency mineral program.

1. The immediate purchase of adequate stock piles of strategic minerals of standard quality as the most effective means of meeting the pressing problems of national defense.

2. The annual appropriation by the Government of $500,000 to be used by the Bureau of Mines and the Geological Survey for the purpose of a comprehensive study of ways and means of adapting our domestic reserves of strategic minerals to a permanent solution of our deficiency mineral problem.

Although there is little hope for tin under point (2), it is gratifying to note that legislation on this subject now pending before Congress, and mentioned in the general summary of this chapter, closely parallels Dr. Finch's constructive program. The funds provided in the various bills are inadequate to supply all the stock-pile requirements, but the impending passage of a bill along these lines indicates that the United States is about to initiate action that eventually may remove the threat to national defense inherent in our dependence on foreign sources of tin and other strategic commodities.

DOMESTIC PRODUCTION

Primary tin.—Mine output of tin in 1938 is estimated at 109 long tons, a decline of 35 percent from the peak of 1937. As usual, Alaska produced virtually all (108 tons) of it; South Dakota contributed only 1 ton.

According to the Geological Survey:

Tin mining in Alaska in 1938 was confined mainly to the placer deposits that have been developed in the extreme western part of Seward Peninsula. Mining in this area has been in progress for a number of years and lately has been decidedly on the increase. In 1938, however, judging from the preliminary reports that have been received, the output of placer tin from this area dropped off somewhat from the high rate established in 1937 but still remained above that of any other year in the entire period during which tin mining has been in progress. Owing to the much lower price that prevailed for tin in 1938, as well as the somewhat smaller quantity produced in that year, the total value of the tin output of Alaska is estimated to have been worth about $100,000 less than in the preceding year.

In South Dakota the Fansteel Mining Corporation operated the Bear Creek mine near Tinton during 1938 and sold a mixed concentrate from which 2,500 pounds of tin ore, containing 1,450 pounds of tin, was obtained. Two other operators reported production of small quantities of tin concentrates from the same region, but apparently the ore was not sold.

Mine production of tin (content) in the United States, 1910–38, by States

Year	Long tons				Value
	Alaska	South Dakota	Other States [1]	Total	
1910	9	17	10	36	$23,447
1911	54	(2)	(2)	63	56,635
1912	116			116	124,800
1913	45	1	3	49	46,699
1914	93			93	66,560
1915	91			91	78,846
1916	124		1	125	122,000
1917	89	9		98	135,600
1918	61	.1	.9	62	118,500
1919	50			50	73,400
1920	14	6		20	22,000
1921	3.6			3.6	2,400
1922	1.3			1.3	912
1923	1.7			1.7	1,623
1924	6.3			6.3	7,028
1925	12.3			12.3	15,980
1926	7.1			7.1	10,400
1927	23.9	.1		24	34,600
1928	36.6	1.8	3.6	42	47,400
1929	34.5	.2	.3	35	35,600
1930	13.1	.2	1.7	15	10,500
1931	3.6	.1		3.7	2,050
1932		.4		.4	220
1933	2.6	.1		2.7	2,400
1934	8	.2		8.2	9,600
1935	44.1	.4		44.5	50,200
1936	101	(3)		101	105,000
1937	166	.8	1.6	168.4	205,300
1938	[4] 108	1		[4] 109	[4] 103,200

[1] California, North Carolina, South Carolina, Texas, and Wyoming.
[2] Figures not available.
[3] Less than 0.1 ton.
[4] Subject to revision.

Secondary tin.—Production of secondary tin declined 22 percent in 1938 as a result of the decreased consumption of virgin metal. A very large part of the secondary tin produced in the United States is recovered from industrial scrap, and curtailment in tin-manufacturing operations is reflected immediately in secondary production figures. Further details on secondary tin in 1938 are given in the chapter on Secondary Metals (Nonferrous).

Secondary tin recovered in the United States, 1925–29 (average) and 1934–38 [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
1934	900	1,800	2,700	7,300	14,900	22,200	25,487,600
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

[1] Figures compiled by J. P. Dunlop, of the Bureau of Mines.

CONSUMPTION

Apparent consumption.—The accompanying table shows the apparent consumption of primary metallic tin in the United States from 1910 to 1938, inclusive. These data do not consider the fluctuations in dealer and consumer stocks, information on which is not always available, consequently they do not reveal precisely the actual trend in consumption. Nevertheless, statistics on apparent consumption are useful in determining long-time trends.

The table shows that apparent consumption reached a peak in 1937 but declined 44 percent in 1938. The figure for 1937, however, exaggerates actual consumption, as there were large accretions to consumers' stocks in that year; 1929 thus stands as the year of maximum tin consumption in the United States.

Production, imports, exports, and apparent consumption of tin in the United States, 1910–38, in long tons

Year	Smelter production	Imports for consumption	Exports (domestic and foreign)	Apparent consumption
1910		46,900		46,900
1911		47,792		47,792
1912		51,800		51,800
1913		46,722		46,722
1914		42,438		42,438
1915		51,600	341	51,259
1916	2,019	61,638	449	63,208
1917	5,415	64,434	263	69,586
1918	9,182	63,620	254	72,548
1919	10,925	40,044	341	50,628
1920	15,761	56,067	927	70,901
1921	10,305	24,197	1,393	33,109
1922	8,132	60,193	1,098	67,227
1923	6,666	68,934	1,046	74,554
1924	434	65,059	959	64,534
1925		76,646	932	75,714
1926		77,159	1,980	75,179
1927		71,142	2,239	68,903
1928		77,970	1,617	76,353
1929		87,127	1,930	85,197
1930		80,734	2,233	78,501
1931		66,064	[1] 1,661	64,403
1932		34,819	[1] 1,117	33,702
1933		63,718	[1] 1,041	62,677
1934		39,986	[1] 1,216	38,770
1935		64,258	[1] 2,292	61,966
1936		76,029	[1] 386	75,643
1937		88,115	[1] 313	87,802
1938		49,699	[1] 205	49,494

[1] Foreign only, 1931–38; domestic not separately recorded.

Consumption by uses.—The following tables show actual consumption of primary and secondary tin by uses, as reported to the Bureau of Mines. Except for tin plate and terneplate figures for 1938 were not available at the time this manuscript was prepared. The data represent the products of the first cycle of manufacture; and, for the purpose of this canvass, any virgin tin emerging from this stage as scrap is considered as secondary metal. The figures thus understate consumption of primary tin, and much of the secondary tin shown duplicates data on the virgin metal because it is metal reclaimed from such byproducts as tin-plate clippings and virgin drosses from tin-plate and tinning mills and other plants consuming virgin tin. In 1937, for example, domestic consumers purchased 82,946 tons of virgin metal, of which 7,523 tons was added to inventories and 75,423 tons processed. Of the tin processed 72,928 tons emerged from the first stage of manufacture in the products shown in the accompanying tables; and 2,495 tons was sold as scrap, was lost, or was added to stocks of metal in process.

Consumption of primary and secondary tin in the United States, 1935–37, in long tons

	1935	1936	1937
Stocks on hand Jan. 1	16,920	14,981	17,978
Net purchases during year [1]	71,392	89,232	101,354
Available supply	88,312	104,213	119,332
Stocks on hand Dec. 31	14,981	17,978	25,984
Total processed during year	73,331	86,235	93,348
Intercompany transactions in scrap (tin content)	1,805	2,827	2,782
Total consumed in manufacturing	71,526	83,408	90,566
Plant losses	353	358	436
Tin content of manufactured products	71,173	83,050	90,130
Primary	55,928	68,232	72,928
Secondary	15,245	14,818	17,202

[1] Includes in 1935—primary 55,584, secondary 2,218, terne 903, scrap 12,687; 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.

Consumption of tin in the United States, 1935–37, by finished products (tin content), in long tons

	1935			1936 [1]			1937		
	Primary	Secondary	Total	Primary	Secondary	Total	Primary	Secondary	Total
Tin plate	27,290	--------	27,290	33,750	--------	33,750	39,221	--------	39,221
Terneplate	208	856	1,064	369	943	1,312	382	1,015	1,397
Solder	9,734	6,910	16,644	12,068	6,682	18,750	12,026	7,832	19,858
Babbitt	3,667	1,485	5,152	5,070	1,609	6,679	4,501	2,272	6,773
Bronze	2,688	2,142	4,830	3,559	2,631	6,190	3,712	2,784	6,496
Collapsible tubes	3,548	--------	3,548	3,556	--------	3,556	3,571	(3)	3,571
Tinning	2,080	2	2,082	2,377	13	2,390	2,585	67	2,652
Foil	1,602	27	1,629	1,645	43	1,688	1,456	4	1,460
Chemicals (other than tin oxide)	693	2,579	3,272	209	1,346	1,555	171	1,331	1,502
Pipe and tubing [2]	950	3	953	1,401	82	1,483	1,278	18	1,296
Tin oxide	1,074	174	1,248	969	361	1,330	793	411	1,204
Type metal	165	859	1,024	253	919	1,172	221	1,140	1,361
Galvanizing	620	--------	620	1,016	--------	1,016	997	(3)	997
Bar tin	368	27	395	656	84	740	652	174	826
Miscellaneous alloys	422	60	482	418	62	480	482	24	506
White metal	347	50	397	358	9	367	374	33	407
Miscellaneous	472	71	543	558	34	592	506	97	603
	55,928	15,245	71,173	68,232	14,818	83,050	72,928	17,202	90,130

[1] Revised figures.
[2] In 1935 pure tin tubing required 940 tons and tin-lined tubing 13 tons; in 1936, 1,476 and 7 tons; in 1937, 1,286 and 10 tons.
[3] Small quantity included under "Miscellaneous."

The principal use of tin is in the manufacture of tin plate. Normally this industry consumes approximately half the virgin tin used in the United States. Production of tin plate declined 40 percent in 1938 compared with 1937. Although the food pack decreased only 10 percent, exports of tin plate fell 55 percent, and can makers drew heavily on inventories purchased before the price rise in 1937.

According to the American Bureau of Metal Statistics, the use of virgin tin in various other products decreased as follows in 1938: Solder, 34 percent; collapsible tubes and foil, 23 percent; babbitt, 38 percent; and bronze, 41 percent.

A new process has been devised for coating copper, brass, and other metallic articles by suspending them in an atmosphere of hydrogen and stannous chloride vapor. The reduced tin alloys with the underlying metal, forming a close bond, and, in the case of copper, a hard tin-copper alloy surface. The process, known as "stannising," is said to be especially adapted to coating objects with an irregular surface, such as screws and bolts.

A. Strauss & Co., Ltd., of London, comments on the growth of substitutes for tin in the United States as follows:

One of the principal uses of tinfoil is the wrapping of cheese. Much of this will be discontinued in the future, and be replaced by a rubberized transparent paper. This substitution, it is stated, will effect a considerable saving in cost. Other changes in industrial processes are resulting in reduced tin consumption. A lead bearing metal, free of tin, is being used in the production of certain automobiles. Substitutes are being increasingly used for tin oxide. The move towards the use of tooth powder instead of tooth paste, brought about by a nation-wide advertising campaign, is diminishing the demand for tooth paste tubes. The increasing popularity of electric shavers is decreasing the sale of shaving cream tubes. Aluminum is now being more freely used in the manufacture of tubes, in view of the high tin price. The tinplate industry still remains, of course, the backbone of tin consumption, but even here new processes are in operation by which the coating of metal has been reduced. An interesting development which may well have some adverse effect on the sale of tinned fruit and vegetables is the new method of refrigeration adopted by the railroad companies. They can now carry to the North throughout the winter fresh vegetables from the South at a figure very slightly above the price of tinned vegetables. The total effect of these developments and substitutions is not serious; they are mentioned as evidence of a tendency.

FOREIGN TRADE [7]

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 declined 44 percent from the all-time peak established in 1937. Eighty-seven percent of the total imports came from Asia, 12 percent from Europe, and 1 percent elsewhere. Receipts from all major producing areas declined in 1938.

Foreign trade of the United States in tin and tin concentrates, 1934–38

Year	Imports				Exports of tin (metal) [1] (long tons)
	Tin (metal)		Tin concentrates (tin content)		
	Long tons	Value	Long tons	Value	
1934	39,986	$44,800,650	2	$859	1,216
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

[1] Imported as pigs, bars, etc., and exported as such.
[2] Less than 1 ton.

[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.

Tin [1] imported for consumption in the United States, 1937–38, by countries

Country	1937		1938	
	Long tons	Value	Long tons	Value
Argentina	130	$164.377	482	$437,762
Australia	95	60,214	130	126.914
Belgian Congo	190	246,418	75	77,376
Belgium	120	171,463	395	394,518
Bolivia	112	137,335	25	22,355
British Malaya	66,709	79,490,432	36,673	32,952,813
Canada	47	53,897	11	8,908
China	4,467	5,126,838	2,084	1,807,756
Cuba			1	481
Germany			20	17,109
Hong Kong	2,068	2,222,866	1,204	1,034,384
India, British	200	208,602		
Indochina, French	20	24,176		
Mexico	201	193,856		
Netherland India	4,105	4,793,256	3,096	2,716,274
Netherlands	2,447	2,958,631	2,216	2,062,990
Sweden			(2)	15
United Kingdom	7,204	8,432,401	3,287	3,200,669
	88,115	104,284,762	49,699	44,860,324

[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, 1934–38, 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
1934	7,868	(1)	(1)	(1)	126	184.651
1935	9,185	34,928	(2)	[2] 24,525	187	134,499
1936	9,873	14,375	(2)	[2] 44,621	233	238,880
1937	12,916	14,126	13,062	26,259	246	360,683
1938	10,444	12,495	4,467	7,255	109	161,578

[1] Data not available.
[2] Tin-plate circles, strips, cobbles, etc., included in waste-waste tin plate.

Foreign trade in miscellaneous tin manufactures and tin compounds, 1934–38

Year	Miscellaneous tin manufactures		Tin compounds (pounds)	
	Imports [1]	Exports [2]	Imports	Exports
1934	$55,525	$677,266	200	202,777
1935	57,945	776,855	22	128,632
1936	73,114	1,295,484	5,959	344,578
1937	43,458	2,532,747	1,715	218,006
1938	11,468	2,064,504	865	172,467

[1] Tin manufactures n. s. p. f.
[2] Includes tin dross and tin-bearing scrap material other than tin-plate scrap.

The 55-percent decline in exports of tin plate, etc., in 1938 was greater than the decline in foreign consumption, indicating that domestic producers lost ground in the export market. Exports from the United Kingdom and Germany decreased only 29 and 12 percent, respectively.

Tin plate, terneplate (including long ternes), and taggers tin exported from the United States, 1937–38, by principal countries and customs districts

Country and customs district	1937		1938	
	Long tons	Value	Long tons	Value
COUNTRY				
Argentina	21,060	$2,483,004	4,434	$556,383
Belgium	4,627	517,930	1,005	111,145
Brazil	29,519	3,391,628	11,743	1,429,917
British Malaya	6,457	675,161	3,175	389,012
Canada	27,971	3,022,623	16,298	1,996,210
Chile	5,588	614,322	2,915	335,211
China	26,464	2,826,778	4,468	589,723
Colombia	4,371	495,571	2,332	296,381
Cuba	12,501	1,449,745	8,075	1,014,551
Egypt	3,847	402,530	2,429	249,686
Hong Kong	15,971	1,737,440	2,654	268,949
India, British	1,056	125,920	5,372	595,999
Italy	6,027	755,766	68	8,429
Japan	42,689	4,484,478	12,799	1,649,174
Kwantung	18,801	2,111,271	1,272	145,299
Mexico	13,842	1,614,326	8,646	1,049,305
Netherland India	6,038	639,283	4,192	452,890
Netherlands	15,861	1,926,995	12,093	1,487,499
Norway	8,664	859,373	2,499	265,487
Peru	4,495	499,846	3,099	351,811
Philippine Islands	12,848	1,383,517	8,940	991,154
Portugal	11,823	1,185,087	853	87,747
Spain	135	14,661	7,154	736,343
Sweden	8,962	903,285	3,871	400,781
Syria	3,094	331,802	2,433	257,337
Turkey in Asia and Europe	8,622	944,675	6,949	736,020
Union of South Africa	10,519	1,090,625	4,668	515,199
U. S. S. R.	7,890	1,023,453	5,660	775,304
Uruguay	10,011	1,170,515	4,567	562,579
Other countries [1]	10,930	1,258,312	6,915	772,416
	360,683	39,939,922	161,578	19,077,941
CUSTOMS DISTRICTS				
Buffalo	10,461	1,092,787	1,582	185,389
Chicago	4,948	548,351	3,181	370,041
Dakota	3,501	436,070	6,481	867,323
Maryland	144,359	15,674,659	72,829	8,461,736
Michigan	5,466	557,337	4,984	564,271
New York	167,676	19,027,746	67,687	8,072,528
Philadelphia	15,460	1,699,328	2,938	331,334
Other districts [1]	8,812	903,644	1,896	225,319
	360,683	39,939,922	161,578	19,077,941

[1] Includes all exports not exceeding $250,000.

PRICES

The average price of Straits tin in New York in 1938 was 22 percent below that of 1937, reacting to the industrial recession that began in the latter half of 1937 and continued into the first half of 1938. The tin quotation at the beginning of 1938 was 41.125 cents per pound. Minor fluctuations occurred during January and February, but toward the last of March a downward trend developed as business continued to lag. The low price for the year—35.00 cents—was recorded on May 2 following a period of uncertainty as to Malaya's position in regard to quota readjustments and buffer pool proposals. Improved deliveries during May, the announcement on June 1 that Malaya would join the buffer pool, and the decision to curtail production further during the third quarter had a pronounced effect on the tin market, and in June and July there was substantial recovery in prices. The following 2 months witnessed little change, but in the closing quarter quotations moved upward with the general improvement in industrial activity. On December 30 the price stood at 46.65 cents; the high for the year was 46.75 cents on December 29.

Tin price data, 1925–29 (average) and 1934–38

	1925–29 (average)	1934	1935	1936	1937	1938
Average prices:						
New York:[1]						
Straits tin____cents per pound__	56.64	52.16	50.39	46.42	54.24	42.26
99.75-percent tin (English refined)____do____	(2)	52.04	50.07	46.29	54.06	42.07
99-percent tin____do____	55.50	51.18	49.28	45.72	53.01	40.84
London:[3]						
Standard tin____£ per long ton__	254.6	230.4	225.7	204.6	242.3	189.6
Do____cents per pound__	55.17	51.83	49.39	45.40	53.48	41.39
Premium allowed over standard:						
Straits____£ per long ton__	5.1	2.0	4.4	2.6	3.0	4.3
Banka____do____	6.9	3.4	5.3	1.7	----	----
English____do____	−.7	1.1	.5	−.4	.4	1.3
Price indexes (1925–29 average=100):						
Straits tin (New York)____	100	92	89	82	96	75
Copper (New York)____	100	58	59	65	90	70
Lead (New York)____	100	52	54	63	80	63
Nonferrous metals[4]____	100	68	69	72	91	74
All commodities[4]____	100	76	81	82	88	80

[1] American Metal Market.
[2] Data not available.
[3] Metal Bulletin, London, as compiled by International Tin Research and Development Council.
[4] Based on price indexes of United States Department of Labor.

Monthly price of Straits tin for prompt delivery in New York, 1936–38, in cents per pound [1]

Month	1936			1937			1938		
	High	Low	Average	High	Low	Average	High	Low	Average
January____	48.37½	46.00	47.24	51.50	49.80	50.89	42.87½	40.00	41.52
February____	48.85	47.50	47.92	55.65	49.90	51.94	42.62½	40.50	41.27
March____	48.87½	47.20	47.99	66.62½	54.10	62.71	42.00	38.00	41.15
April____	47.62½	46.50	46.94	63.50	55.00	58.99	39.90	36.60	38.34
May____	47.00	44.75	46.30	57.12½	54.62½	55.63	38.25	35.00	36.84
June____	44.50	40.50	42.22	57.25	54.62½	55.84	43.00	37.50	40.35
July____	44.75	40.50	42.97	60.25	57.50	59.31	44.25	42.60	43.37
August____	43.30	42.00	42.57	60.37½	58.25	59.40	43.90	42.80	43.26
September____	46.00	42.87½	44.74	59.87½	55.62½	58.62	44.50	42.65	43.38
October____	46.37½	43.95	44.94	57.37½	47.62½	51.46	46.40	43.50	45.22
November____	53.50	45.85	51.31	47.62½	41.00	43.30	46.70	45.60	46.23
December____	52.85	50.62½	51.85	44.75	41.00	42.85	46.75	45.85	46.18
Year____	53.50	40.50	46.42	66.62½	41.00	54.24	46.75	35.00	42.26

[1] Metal Statistics, 1939, pp. 379 and 381.

STOCKS

Total stocks of virgin tin on hand in the United States at the end of 1938, and metal afloat, decreased 15 percent over 1937. Visible supplies—that is, afloat, at landings, or in licensed warehouses in New York—declined 34 percent during 1938, and stocks at consumers' plants were approximately the same at the beginning and end of the year. The total material on hand December 31, 1938, was equivalent to only a 6.5-month supply at the average rate of consumption in 1938.

World visible supply, exclusive of consumers' stocks, increased 21 percent, as shown in the accompanying table. These data do not include stocks of metal being accumulated by various countries as a reserve against a military emergency. The U. S. S. R. apparently stocked 20,000 to 25,000 tons for this purpose during 1937 and 1938.

Recent sharp increases in tin shipments to Japan, Germany, Poland, and Sweden suggest that these countries, also, may be acquiring stock piles. The Navy Department of the United States Government had on hand, as of March 1939, an emergency reserve of 2,190 tons of tin.

Stocks of virgin pig tin in the United States December 31, 1934–38, in long tons

	1934	1935	1936	1937	1938
Location of stocks:					
Afloat to United States [1]	4,002	7,650	10,857	7,678	4,150
At landings in New York [1]	1,585	2,192	4,990	4,106	1,837
In licensed warehouses in New York [1]	1,053	120	105	2,279	3,320
Total visible supply [1]	6,640	9,962	15,952	14,063	9,307
Consumers' stocks [2]	9,857	7,786	10,238	17,761	[3] 17,800
Total stocks on hand	16,497	17,748	26,190	31,824	27,107

[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] Partly estimated.

Visible stocks of tin in the world and in the United States at end of each month, 1925–29 (average) and 1934–38, in long tons [1]

Month	1925-29 (average)		1934		1935		1936		1937		1938	
	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	28,724	8,209	18,535	2,581	17,233	2,985	26,179	5,478	27,101	4,866
February	19,620	3,027	28,296	7,014	23,426	3,571	17,562	3,525	23,774	4,956	25,261	5,116
March	18,312	2,803	25,010	6,459	22,165	4,531	18,664	3,968	24,127	5,731	29,125	4,458
April	17,765	2,189	22,886	5,649	20,324	4,295	16,869	2,713	24,593	4,741	30,606	4,447
May	19,085	2,384	21,580	5,089	19,074	4,930	18,380	2,941	23,721	5,144	27,909	3,679
June	18,250	2,390	20,587	5,094	16,221	5,467	16,448	3,054	23,291	4,810	29,061	4,247
July	18,164	2,675	20,939	6,461	16,173	3,227	16,759	2,151	25,646	6,193	31,097	4,071
August	18,339	2,450	19,676	4,968	16,306	2,681	17,642	3,095	26,016	5,850	32,251	5,232
September	18,317	2,425	18,833	4,243	14,564	2,849	16,896	2,860	23,014	3,538	32,476	4,573
October	18,356	2,899	20,624	4,998	16,138	1,389	19,048	3,315	22,865	3,280	31,539	4,500
November	19,058	2,373	19,239	4,048	16,804	1,472	23,148	3,030	24,389	5,285	30,598	5,060
December	20,557	2,277	18,172	2,638	15,318	2,312	23,787	5,095	27,044	6,385	30,554	5,157
Average	18,744	2,573	22,046	5,406	17,920	3,275	18,536	3,228	24,555	5,116	29,798	4,617

[1] Metal Statistics, 1939, pp. 369 and 371. Beginning January 1930, figures for world stocks include carry-over in the Straits Settlements (on lighters and warrants); beginning July 1933, they also include carry-over at Arnhem (Netherlands) smelter.

WORLD ASPECTS OF TIN INDUSTRY

International Tin Control Scheme.—During the first quarter of the year countries signatory to the production-control scheme were operating under quotas representing 70 percent of standard tonnages, a sharp reduction from the 110 percent maintained during most of 1937. This curtailment was necessitated by the drop in demand the last 3 months of 1937. As business continued slack in 1938, production quotas were reduced to 55 percent for the second quarter and to 35 percent for the third and fourth quarters. Standard tonnages of Malaya and Netherland India were increased 7.5 percent effective July 1, 1938. Because this drastic curtailment by signatory countries was not met by the nonsignatory producers, the output of the latter rose to a proportion that would have permitted resignations from the Tin Control Scheme. The original agreement provides that when outside production "has, over a period of 6 consecutive months, exceeded 15 percent of the estimated world production during that period, or 12,500 tons of metallic tin, whichever is the less amount, it shall be competent for any territory to give 6 months' notice of its intention to withdraw from the Scheme." The right provided in the foregoing section was not exercised by any signatory country during 1938. According to E. Baliol Scott,[8] participants in the Buffer Stock Scheme contracted themselves out of this privilege.

The Buffer Stock Scheme proposed in 1937 was formally ratified and put into effect on July 1, 1938. The object of the scheme is to stabilize the price of tin. Limits of £200 and £230 per long ton (43.5 to 50.0 cents per pound with exchange at par, $4.8665) are provided, subject to change by resolution of the International Tin Committee (I. T. C.). The agreement provides for an initial stock of 10,000 tons, which can be increased to a maximum of "approximately 15,000 tons" by resolution of the I. T. C. The stock is to be administered by an executive who is in no way interested personally in the tin industry and who will be guided by general instructions issued from time to time by the I. T. C. In general, the operations of the executive are not to be revealed to any person other than the chairman of the I. T. C., but data on the quantity of tin held and the financial status are to be given to the I. T. C. where tin-control quotas are being considered. The original stock is to be supplied pro rata by members of the tin-control scheme, who likewise will participate pro rata in the proceeds from its sale. The agreement terminates on January 1, 1942.

The draft of the Buffer Pool Scheme was approved by the I. T. C. on March 14, 1938, and submitted to the signatory countries for ratification. Some objection to the scheme was encountered in Malaya, but on May 23 the plan was ratified by Malaya by a 2 to 1 vote. In June the I. T. C. established production quotas for the third quarter at 35 percent for the regular market trade and an additional 10 percent for the creation of the buffer stock. These percentages were reaffirmed for the last quarter of the year. R. G. Mills, a director of the Brazilian Warrant Agency & Finance Co., was appointed manager of the buffer pool in August. Details of the pool's activity during the last half of 1938 were not revealed, but apparently over 10,000 tons were accumulated by the end of the year. On November 22 the I. T. C. voted to increase the buffer stock to 15,000 tons. Production quotas for the first quarter of 1939 were retained at 35 percent for market and 10 percent for stock accumulations.

World mine production.—Mine production of tin decreased 30 percent in 1938 compared with 1937. Much of the decline was absorbed by the countries signatory to the International Tin Control Scheme, their output being decreased 33 percent compared with only 10 percent for the nonsignatory countries. British Malaya continued to be the largest producer and contributed 29 percent of the total world output. Bolivia ranked second with 17 percent, Netherland India third with 14 percent, Siam fourth with 9 percent, and China fifth with 8 percent. The output of the unrestricted producers comprised 19 percent of the total production in 1938 compared with 15 percent in 1937 and 11 percent from 1925 to 1929. There were no outstanding new producers in 1938.

[8] Scott, E. Baliol, Tin in 1938: Mining Jour. (London), Mar. 4, 1939, p. 165.

World production of tin (content of ore), 1925–29 (average) and 1934–38. by countries in long tons

[Compiled by R. B. Miller

Country	1925–29 (average)	1934	1935	1936	1937	1938
Restricted production:						
Belgian Congo	967	3,654	5,301	6,301	8,942	[1] 7,316
Bolivia [1]	37,169	22,857	25,007	24,052	25,128	25,484
Indochina	691	1,132	1,309	1,381	1,577	1,575
Malay States:						
Federated [1]	54,606	36,385	40,780	64,719	75,393	41,077
Unfederated	2,206	1,239	1,542	1,979	2,075	1,961
Straits Settlements	25	51	52	58	72	99
Netherland India	33,266	19,680	20,140	30,728	39,165	[1] 21,001
Nigeria	8,319	5,000	6,557	9,739	10,782	[1] 7,305
Portugal	(2)	572	730	809	(2)	(2)
Siam	8,204	10,638	9,876	[1] 12,526	[1] 15,985	[1] 13,616
United Kingdom	(2)	1,999	2,050	2,099	(2)	(2)
Total signatory countries	145,453	103,207	113,344	154,391	179,119	119,434
Unrestricted production:						
Argentina	32	254	700	940	1,840	[3] 1,800
Australia	2,830	2,986	3,130	3,361	3,607	3,150
Burma	2,228	4,061	4,102	4,546	4,636	3,800
Cameroun, French	----------	138	217	217	232	217
China [1]	7,085	6,386	9,078	11,123	12,871	11,606
Germany	98	----------	26	50	[3] 100	(4)
Italy	----------	----------	----------	36	131	271
Japan	625	1,821	2,197	2,329	[3] 2,257	[3] 2,190
Mexico	2	16	621	368	373	249
Morocco, French	4	41	40	25	14	27
Peru	----------	1	----------	97	45	24
Portugal	625	(5)	(5)	(5)	1,095	764
Portuguese East Africa	5	----------	7	14	6	(4)
Rhodesia:						
Northern	----------	----------	5	5	5	3
Southern	15	8	7	47	139	267
South-West Africa	149	136	164	162	169	164
Spain	145	230	300	104	127	(4)
Swaziland	138	114	127	128	108	113
Tanganyika	22	103	145	207	243	[1] 263
Uganda	98	314	397	409	361	283
Union of South Africa	1,174	570	622	634	537	561
United Kingdom	2,658	(5)	(5)	(5)	1,987	1,930
United States	24	8	45	101	168	109
Total nonsignatory countries	17,957	17,187	21,930	24,903	31,051	28,000
Grand total	163,000	120,400	135,300	179,300	210,200	147,500

[1] Exports.
[2] See entry under "Unrestricted production."
[3] Estimated.
[4] Estimate included in total.
[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 differs materially from those on mine output. For example, all ore from Bolivia and Nigeria is smelted in Europe. An appreciable part of the tin ore from Netherland India 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.

Smelter production of tin, 1925–29 (average) and 1934–38, in long tons

[Compiled by R. B. Miller]

Country	1925–29 (average)	1934	1935	1936	1937	1938
Argentina		209	591	591	680	(1)
Australia	2,952	2,330	2,837	2,717	2,907	(1)
Belgian Congo			1,588	1,955	2,313	(1)
Belgium [2]	720	3,900	4,000	5,100	5,400	(1)
British Malaya [3]	88,855	49,637	60,479	84,591	95,372	63,746
China	[4] 7,080	7,878	9,700	10,400	11,100	[4] 11,606
Germany [5]	3,444	2,156	2,042	2,293	2,671	(1)
Italy			241	286	75	271
Japan	606	1,199	2,027	1,830	1,840	(1)
Netherland India [4]	14,749	10,506	11,221	12,854	13,757	7,208
Netherlands [2]	[6] 1,000	13,400	15,600	20,900	26,600	25,560
Norway	(1)	174	454	233	241	(1)
Portugal	[7] 2	39	1			(1)
Siam	[8] 113	(9)	(9)			(1)
United Kingdom [2]	45,800	25,600	29,100	34,200	33,800	37,000
	165,000	117,000	140,000	178,000	196,800	(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 1938 decreased 24 percent from 1937, according to the International Tin Research and Development Council. This authority states that apparent consumption in the United States declined 41 percent compared with only 10 percent elsewhere. The principal consumers in 1938 and the percentage of the total each consumed were as follows: United States, 33 percent; United Kingdom, 12 percent; U. S. S. R., 11 percent; Germany, 9 percent; Japan, 7 percent; and France, 6 percent. Of these countries Germany and Japan were the only ones to use more tin in 1938 than in 1937. Italy also increased its tin consumption in 1938. The decline in consumption by the U. S. S. R. was due largely to completion of a stock-piling program mentioned elsewhere in this report.

Apparent tin consumption of the world, 1926–29 (average) and 1934–38, by countries, in long tons [1]

Country	1926–29 (average)	1934	1935	1936	1937	1938
Belgium	1,231	1,219	1,250	1,336	1,520	1,618
Canada	2,346	1,786	2,086	2,164	2,625	2,355
Czechoslovakia	1,513	1,101	1,277	1,684	1,731	1,560
France	10,260	9,348	8,210	9,748	9,175	9,049
Germany [2]	12,444	10,658	11,083	9,164	12,392	13,474
India, British	2,704	2,222	2,541	2,293	2,595	2,494
Italy	4,268	4,118	6,641	3,642	3,584	4,618
Japan	4,506	5,190	6,221	6,403	8,190	10,963
Netherlands	980	1,090	1,232	1,284	1,470	1,400
Poland	589	739	907	1,322	1,272	1,819
Spain	1,565	1,519	1,713	826	942	1,082
Sweden	1,373	1,708	1,900	1,692	1,897	2,895
Switzerland	1,742	928	1,001	1,109	1,100	1,259
United Kingdom	21,988	21,073	21,427	21,860	25,971	18,290
U. S. S. R.	3,791	5,802	7,311	9,664	25,125	16,174
United States	76,539	43,638	62,470	73,039	86,663	50,724
Other countries	15,036	10,961	12,030	12,570	12,448	11,826
	162,875	123,100	149,300	159,800	198,700	151,600

[1] As estimated by the Tin Research and Development Council.
[2] Includes Austria; the Saar is also included after Feb. 17, 1935.

REVIEW BY COUNTRIES

Argentina.—In 1935, it was reported that the Patino, National Lead, and St. Joseph Lead Cos. jointly purchased a 10-year lease on a property in the neighborhood of Rio Rincanada, believed to contain 40,000 tons of tin. A smelter was erected in Buenos Aires. There has been a steady increase in production each year, and in 1938 the output of this property is believed to have reached about 1,700 tons of tin, of which approximately 1,200 tons were smelted in Buenos Aires, and the rest was shipped to Holland for treatment in the form of concentrates.

Bolivia.—Owing to the drastic reduction in export quotas in 1938, Bolivia could meet her allotment for the first time since 1933. In 1937 Bolivian exports were 24,373 tons below the permissible total, but in 1938 actual exports exceeded the quota by 3,516 tons. Production has been retarded by the shortage of manpower resulting from the war with Paraguay. Agitation to allot a larger share in exports to the Hochschild group was considered, and on October 4, 1938, a Presidential decree reduced Patino's share for the last quarter of 1938 from 50.34 to 46 percent and increased Hochschild's quota to 26 percent (from 18.8 percent). The decree assigned 5 percent to the Aramayo group, 13 percent to the medium-size producers, and 10 percent to the small miners (defined as those producing less than 60 tons in 1937). However, early in 1939 it was reported that Hochschild's quota was lowered by 5 percent and those of Patino and Aramayo raised 2 percent.

The October 4 action was predicated on the allegation that Patino's reserves are on the decline while Hochschild's reserves and producing capacity are increasing. The annual report of Patino Mines & Enterprises Consolidated, Inc., for 1937, contains the following statement by Patino: "The reduction in our reserves during the last 3 years is caused largely by the insufficiency in the number of workmen available." The proved reserves on December 31, 1937, were 59,291 tons. Patino also states that "Patino Mines and my own companies will always be ready to consider any proposal permitting the establishment of smelters in the United States, providing that the technical and economic difficulties which the project involves can be solved."

Of the 27,886 tons of Bolivian concentrates exported in 1938, 73 percent was treated in England; of the remainder, 26 percent was treated in Germany and Holland. The smelting of tin in Bolivia has been proposed from time to time, and several unsuccessful attempts to do so have been made in the past. These failures have been due to the refractory nature of Bolivian ores and the lack of a cheap fuel supply within the country. More recently, electrolytic methods have been emphasized, and Minerals Yearbook, 1938, called attention to the proposed erection of tin smelters at Oruro, using the Lamy electrolytic process. No further news regarding progress in this venture during 1938 has come to the attention of the Bureau of Mines.

A Supreme Resolution of September 16, 1938, definitely established Bolivia's participation in the Buffer Stock Scheme. The buffer stock formed in June 1934 became ineffective when Bolivia decided in June 1935 to terminate the agreement.

British Malaya.—During the first half of 1938 British Malaya had an operative standard tonnage of 81,831 tons per annum, consisting of a standard allotment of 71,940 tons and 9,891 tons surrendered by or acquired from other producing countries. As of July 1, 1938, the surrendered and acquired tonnages became inoperative, but British Malaya's standard tonnage was increased 7.5 percent to 77,335 tons.

The 44-percent decline in Malaya's tin output in 1938 caused severe unemployment problems. The number of tin miners decreased from 88,285 at the beginning of 1938 to 57,663 at the end. Most of the idle workers were Chinese who had not returned to China owing to the Sino-Japanese War. To alleviate the situation, the Malayan Government is restricting immigration and accelerating public works to absorb labor on a large scale. It is also financing the production of additional ore above export quotas, which is to be stored and used later in meeting export allowances. Employers likewise are spreading the work to relieve unemployment.

Curtailment in production has been accomplished largely by stopping dredge operations. Normally, dredging is the principal means of ore production, but during several months in 1938 gravel pumping supplied the greater portion of the output. The future of tin mining in Malaya lies in the working of low-grade ground by dredges; and at present about 115 dredges are available. During the summer of 1937 as many as 95 of these were working, and several were being built or were on order. By the end of 1938, however, the number of active dredges had dropped to 55.

Comparatively speaking, Malaya enjoys an enviable position in the tin industry as a low-cost producer. Some operators believe that the production-control scheme has reacted to the detriment of Malayan producers and to the benefit of high-cost producers elsewhere. Sir John Bagnall, of Straits Trading Co., Ltd., for example, has suggested that Malaya would be better off with the greater employment that would result from a larger share in world production at a price of £100 for tin.[9]

For some time Malayan Government land policies have been criticized on the basis that prospecting was being stifled and that in consequence the tin reserve position was threatened. The Mines Department undertook a survey of reserves and issued an estimate of 1,000,000 tons of tin, representing only 10 years' life at the potential producing capacity of 100,000 tons per annum. Sir Lewis Fermor, formerly Director of the Geological Survey of India, was engaged to study the problem and to report to the High Commissioner. Although there were indications that the land restrictions would be eased, no definite action was taken during 1938.

China.—In December 1938, A. Strauss & Co., Ltd., reported that—

> The invasion of South China by the Japanese has stopped the exports from the Kwangsi and Kwangtung Provinces, which together amount to about 3,500 tons per annum. The only source of supply is now the Yunnan Province, whose production is approximately 9,000 tons. This metal is shipped via Haiphong. It would therefore appear that the export of about one-quarter of the Chinese tin has been affected by the Japanese invasion.[10]

[9] Mining Journal (London), vol. 201, No. 5355, Apr. 9, 1938, p. 375.
[10] Strauss, A., & Co., Ltd., London, and Strauss, Caswell, & Co., Inc., N. Y., Monthly Review of the Tin Market: November 1938.

The Chinese tin-mining industry has been described by Ahlfeld in Metal und Erz for May 1938. An abstract in English is given in the London Mining Journal of June 11, 1938, page 566.

Germany.—Germany (including Austria) produces little tin; and, despite major efforts to provide substitutes, apparent consumption increased from 9,164 tons in 1936 to 13,474 in 1938. The acquisition of Czechoslovakia increased Germany's dependence on imported tin, as consumption there has averaged over 1,600 tons annually from 1936 to 1938, with little or no local production. In August 1938 it was reported that exploration in the lower levels of the old tin mines near Carlsbad, West Bohemia, disclosed large ore bodies containing about 1 percent tin. Production from this area, adequate for Czechoslovakia's needs, was expected. The ore was to be smelted in Germany. Details on developments since the Munich Agreement are not available.

Germany imported 6,045 tons of tin ore in 1938, of which 5,845 tons came from Bolivia. Imports of metallic tin (crude, scrap, and alloys) totaled 11,900 tons in 1938.

Italy.—Italy's tin requirements are supplied largely by imports of metallic tin, which amounted to 4,371 tons in 1938 and were obtained chiefly from British Malaya and neighboring European countries. The small production credited to Italy represents the output of two small mining operations and the tin recovered from scrap.

Japan.—Japan produces only a portion of its tin requirements, which have increased rapidly during the past 2 years. Most of the domestic ore has been smelted locally, but the product of some mines has been shipped to Singapore for treatment. To make Japan more self-sufficient in tin domestic production is being stimulated, and a tin property in Siam has been acquired by one of the larger Japanese companies. Smelting facilities are being increased to permit a larger proportion of imports in the form of ore. Recovery of secondary tin and use of substitutes are being encouraged, and distribution of the metal is controlled.

Netherland India.—Interest in the proposed merger of the Banka and Billiton operations, mentioned in Minerals Yearbook, 1938, appears to have waned in 1938. According to press reports, one reason for the proposed merger was to place the more aggresive management of Billiton in charge of operations at Banka, where mechanization and the development of low-grade reserves have lagged. In view of this statement the recent acquisition of large dredges by the Banka company is significant. Not only was the Kantoeng dredge, which was lost in the North Sea in 1937 en route to Netherland India, replaced with an even larger unit, but another large dredge was authorized by the Batavian Government. Considerable progress has been made in mechanizing other mining operations, and steam shovels and tractor scrapers are supplanting hand methods to a considerable extent.

In contrast to Banka, the Billiton company has 18 bucket dredges available. The recently completed Karimata dredge was temporarily engaged in dredging for treasure lost with the Lutine, which sank in the North Sea off the harbor of Terschelling at the end of the eighteenth century. When this unit arrives at Billiton, the company will have 14 dredges at this island and 4 at Singkep. Recent increases in capacity by the Banka and Billiton companies may have been inspired in part by a desire to improve the bargaining power of the Netherlanders in anticipation of negotiations for continuance of the present control scheme which expires at the end of 1941.

Although Billiton has more modern production facilities than Banka and can work lower-grade deposits, Banka has a much superior position in regard to grade and quantity of its tin reserves. Costs of production at Banka are thus considerably below those at Billiton.

During 1937 the operative tonnage of Netherland India under the Tin Control Scheme was 41,324 tons, including a standard allotment of 36,330 and 4,994 tons of acquired tonnage and carry-over. The acquired tonnage was surrendered as of July 1, 1938; but, effective the same date, the standard tonnage was increased 7.5 percent to 39,055 tons by the International Tin Committee. Exports of tin (content) amounted to 21,001 tons in 1938, of which 7,208 tons was metal and 13,793 tons was in tin content of ore. All the 18,700 tons of ore exported went to the Netherlands. Banka produced 12,545 tons and Billiton and Singkep 8,456 tons of the total tin exported.

Netherlands.—Production of tin at the Arnhem smelter decreased in 1938 from 26,600 to 25,560 tons and ore receipts from 39,600 to 38,200 tons. A substantial decline in ore shipments from Netherland India was partly offset by the larger tonnages from Bolivia and other countries. Of the total ore imports in 1938, 68 percent was derived from Netherland India, 28 percent from Bolivia, and 4 percent elsewhere. Exports of tin decreased from 25,300 tons in 1937 to 24,000 tons in 1938.

Nigeria.—The trade agreement signed by the United States and the United Kingdom on November 17, 1938, removes the 5-percent tax on exports of Nigerian tin ores shipped to the United States, effective January 1, 1939. This action is discussed further in the general summary at the beginning of this chapter.

The inability of Nigerian producers to meet their quota allotments in 1937 led to hurried attempts to increase capacity, and much machinery and other plant equipment previously ordered were installed during 1938, although it was not needed to meet the curtailed output for that year.

Total reserves of proved and probable ore, as compiled by the London Mining Journal (Nov. 26, 1938, p. 1092), amounted to approximately 123,000 tons (about 72 percent tin content) of which Associated Tin Mines of Nigeria, Ltd., and London Nigerian Tin Mines, Ltd., controlled 70 percent. Effective January 1, 1938, the managements of these companies were consolidated under Anglo-Oriental Nigeria, Ltd., and during the latter part of the year a complete merger into a new company called Amalgamated Tin Mines of Nigeria, Ltd., was proposed. This group contributed 5,566 of the 7,305 tons of tin exported from Nigeria in 1938. Nigerian concentrates are smelted in the United Kingdom.

United Kingdom.—Despite the drastic curtailment in mine production of tin throughout the world in 1938, British smelters increased their output over 9 percent. Imports of ore increased from 51,753 tons in 1937 to 55,553 in 1938. Of the 1938 total, 66 percent came from Bolivia, 20 percent from Nigeria, 9 percent from other British possessions, and 5 percent elsewhere. Receipts from Bolivia increased while those from Nigeria decreased in 1938. The decline in prices during 1938 forced some of the old tin mines in Cornwall to close. A plea was made to the Government for a subsidy to assist the Cornish industry, but it was denied.

U. S. S. R.—According to the International Tin Research and Development Council, apparent consumption of tin in the U. S. S. R. increased from an average of 7,600 tons in 1934–36 to 25,125 tons in 1937, then declined to 16,174 tons in 1938. These figures are based on tin shipments from producing countries. The larger shipments during 1937 and 1938 bear out press reports that the U. S. S. R. was accumulating a reserve stock of tin. Imports reported by the U. S. S. R. were 9,664 long tons in 1936, 12,309 tons in 1937, and 7,847 tons in 1938. Comparison of apparent consumption for 1937 and 1938 with previous years and with official Soviet import data indicates that 20,000 to 25,000 tons of tin may have been stocked for emergency use.

ARSENIC AND BISMUTH

By HERBERT A. FRANKE [1]

SUMMARY OUTLINE

ARSENIC

Production of white arsenic in the United States declined only 1 percent in 1938 as a result of reduced activity at nonferrous smelters where all domestic arsenic is obtained as a byproduct. Imports dropped 26 percent, yet comprised 57 percent of the total apparent consumption, which decreased 28 percent. Although boll-weevil infestation in the Southern cotton fields was severe in 1938, low cotton prices restricted farmers' purchases of calcium arsenate and the financial situation of the railroads curtailed the use of sodium arsenite in weed killing. Lead arsenate requirements of the fruit industry were about normal in 1938. Of outstanding significance in insecticide consumption was the fight waged by Federal and State Governments against outbreaks of grasshoppers and Mormon crickets in the Western Great Plains States and the white-fringed beetle in the South. White arsenic quotations at New York remained at the low price of 3 cents per pound.

Salient statistics for arsenic in the United States, 1925–29 (average) and 1935–38

	1925–29 (average)	1935	1936	1937	1938
WHITE ARSENIC					
Domestic sales: [1]					
Crude ....short tons..	2,364	6,985	8,755	10,903	9,428
Refined ....do....	10,035	5,685	6,826	6,733	3,732
Imports for consumption ....do....	10,769	15,075	17,586	19,256	14,238
Apparent consumption [2] ....do....	(3)	26,945	32,167	34,692	25,098
Average value for domestic sales: [1]					
Crude ....cents per pound..	2.69	1.47	1.52	1.33	1.40
Refined ....do....	3.57	2.57	2.58	1.86	1.73
OTHER ARSENICALS					
Imports for consumption:					
Metallic arsenic ....pounds..	208,672	64,376	81,671	150,659	16,868
Sulfide (orpiment and realgar) ....do....	575,506	710,967	355,463	502,418	241,602
Arsenic acid (H_3AsO_4) ....do....	14,692	150	149	684	55
Calcium arsenate ....do....	1,452	182,900	817,200	796,243	400,000
Lead arsenate ....do....	[4] 2,133			551	
Sheep dip ....do....	135,929	163,660	224,097	208,060	168,932
Paris green and London purple ....do....	4,402	38,085	33,207	108,825	103,556
Sodium arsenate ....do....	82,105	11,411	4,694	13,482	11,881
Exports:					
Calcium arsenate ....do....	[5] 2,159,168	4,104,810	6,294,563	5,383,365	5,242,882
Lead arsenate ....do....	[5] 1,328,828	1,156,922	827,560	1,042,880	1,021,345

[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.

[1] Figures on imports and exports (except as indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

Although complete data on world arsenic production are not available, total output probably declined about 4 percent in 1938. As heretofore, Sweden was the largest world producer. The probable order of importance of other producing countries was as follows: United States, Mexico, France, Germany, Belgium, Australia, and Japan.

PRODUCTION

Production and sales of white arsenic (arsenious oxide) in the United States in 1938 declined 1 and 25 percent, respectively, compared with 1937. Producers continued to market more of the crude than the refined product.

The three domestic producers in 1938 were American Smelting & Refining Co., Anaconda Copper Mining Co., and United States Smelting, Refining & Mining Co. The first of these placed a plant for the recovery of arsenic-bearing dust in operation at its El Paso (Tex.) smelter. This plant is expected to produce 56 to 60 tons of arsenic monthly.

Crude and refined white arsenic produced and sold in the United States, 1934–38

Year	Crude			Refined			Total		
	Production (short tons)	Sales [1] Short tons	Sales [1] Value	Production (short tons)	Sales [1] Short tons	Sales [1] Value	Production (short tons)	Sales [1] Short tons	Sales [1] Value
1934	8,997	9,030	$425,680	4,099	6,593	$371,598	13,096	15,623	$797,278
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

[1] Includes sales by domestic producers for export.

Average receipts from sales in 1938 were 1.40 cents per pound for crude arsenic and 1.73 cents for refined arsenic, indicating a 5-percent increase from 1937 in the selling value of crude and a 7-percent reduction for refined arsenic.

Of the total sales in 1938, 72 percent was crude and 28 percent refined arsenic. In 1937 only 62 percent of the total sales was crude. All domestic crude arsenic was recovered as a byproduct from the smelting of lead and copper ores. 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 95 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 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

The apparent consumption (sales plus imports minus approximate exports) of white arsenic in the United States in 1938 totaled 25,098 short tons compared with 34,692 tons in 1937. Net imports were 48 percent of the 1938 consumption. In addition to white arsenic many other arsenic products were imported for consumption; details are shown in the table of salient statistics at the beginning of this chapter.

The distribution of sales of domestic arsenic in the United States in 1938 was approximately as follows: Insecticides, 47 percent; weed killer, 30; wood preservative, 3; glass manufacture, 2; and miscellaneous, 1. Exports comprised 17 percent of the domestic sales. Most of the white arsenic imported is used by insecticide manufacturers on the Atlantic and Pacific seaboards.

In 1937 production of calcium arsenate totaled 37,001,959 pounds (43,295,354 in 1935) and of lead arsenate 63,291,440 pounds (52,145,851 in 1935).[2] The production and consumption of calcium arsenate usually fluctuate much more than that of lead arsenate. Although consumption of the arsenicals lagged in 1938, use of calcium and lead arsenates in the United States increased approximately 275 and 245 percent, respectively from 1919 to 1936.[3] The use of insecticides has advanced owing to the increased numbers of the older insect species in the United States because of more intensive cultivation and planting and to the advent of new insect pests. The retail cost of all insecticides and fungicides sold in the United States is estimated to exceed $100,000,000 annually, and despite the warfare waged against them, insects and injurious fungi are believed to cause damage approximating $3,000,000,000 annually. Regulations to protect the consuming public require that foodstuffs not only be free from insects but of poisonous insecticidal residues. The latter requirement has stimulated some substitution of organic insecticides less toxic to man for poisonous arsenicals.[4] These new insecticides (rotenone, pyrethrum, etc.) cost more than arsenicals, and their use is not yet extensive from a tonnage standpoint. However, in combating the Mexican bean beetle, magnesium arsenate has largely been replaced by rotenone and deguelin insecticidal constituents derived from roots of the derris vine and cubé plant.

Data are not available on the total domestic consumption of the various arsenic insecticides and fungicides in 1938. The boll-weevil infestation was worse in the Gulf Coast States (Mississippi, Texas, Louisiana, and Alabama) and in Georgia in 1938 than in 1936 and 1937. Estimates (based on manufacturers' production) place calcium arsenate consumption at 45,000,000 pounds in 1936 and about half that quantity in 1937. However, large quantities of calcium arsenate often are purchased by dealers and farmers in anticipation of a serious boll-weevil infestation that does not occur, and this material is not consumed until a succeeding year. It is believed that in 1938 substantial quantities of left-over calcium arsenate were consumed and that farmers could not afford to purchase all necessary requirements because of the prevailing low cotton prices. Calcium arsenate also was used to kill cotton-leaf worms and white-fringed beetles in 1938. Lead arsenate is used regularly to exterminate fruit insects, and consumption in 1938 probably was about that in 1937 (44,000,000 pounds). A large quantity also was used to control Japanese beetles

[2] U. S. Department of Commerce Census of Manufactures: 1937.
[3] Roark, R. C., Insecticides and Fungicides, 1918–38: Chem. Ind., vol. 42, No. 6, June 1938, pp. 636–639.
[4] Roark, R. C., Agricultural Products as Insecticides: Ind. and Eng. Chem. (Ind. Ed.), vol. 31, No. 2, February 1939, pp. 168–171.
Woodbury, E. N., Advances in Entomology during 1938: Ind. and Eng. Chem. (News Ed.), vol. 17, No. 1, January 10, 1939, pp. 13–16.

in the Eastern States. Paris green, another arsenical insecticide, was used in truck gardening.

During 1938 the Federal Government purchased and used 1,400,000 gallons of liquid sodium arsenite for grasshopper bait, 297,368 pounds of dry sodium arsenite to destroy Mormon crickets, and 35,000 pounds of calcium arsenate to kill white-fringed beetles. The Department of Agriculture estimates that in 1939 Federal arsenical purchases will exceed 2,100,000 gallons of liquid sodium arsenite, 447,000 pounds of dry sodium arsenite, and 792,000 pounds of calcium arsenate. These insecticides will be used to fight the annual grasshopper and Mormon cricket invasions west of the Mississippi River and to make a more determined stand against white-fringed beetles, newcomers in the Southern States since 1936.

Sheep dips for the extermination of parasites often are made with sodium arsenate, white arsenic, and arsenious sulfide.[5]

The drop in metallic arsenic imports also indicates a decrease in consumption in 1938 owing to the general decline in industrial activity. As in previous years the United States depended on German metal for all of its requirements. Importers of the metal include The Ore & Chemical Corporation, 80 Broad Street, and Pfaltz & Bauer, 305 5th Ave., both of New York, N. Y.; consumers of the metal include the National Lead Co., 111 Broadway, and the American Smelting & Refining Co., 120 Broadway, both of New York, N. Y. Most of the metallic arsenic is used as a metal hardener, as a flux, and in certain alloys. The addition of arsenic to lead-base bearing alloys helps prevent segregation and raises the hardness at both normal and elevated temperatures.[6] Arsenic in copper has a small hardening and strengthening effect, especially in the cold-worked condition, and raises the recrystallization temperature but is virtually without effect on ductility. It decreases the conductivity considerably. It occurs naturally in Lake copper and often is added to electrolytic copper in small amounts.

Arsenical compounds are being used more extensively in medicinal preparations. Among those used in fighting venereal diseases are arsphenamine, neoarsphenamine, sulfarsphenamine, and tryparsamide. The number of doses of arsenicals distributed by State health departments increased from 1,567,348 in the fiscal year 1937 to 2,799,110 in the 1938 fiscal period.

PRICES

Domestic quotations for white arsenic at New York remained at the low price of 3 cents per pound, carload lots, throughout 1938. Quotations for less than carload lots were 3¾ cents per pound. In recent years white arsenic from foreign sources has enjoyed the benefit of depreciated European currencies and thus has offered considerable competition on both the eastern and western seaboards. The following table shows the slight fluctuations in the price of various arsenical compounds during 1937 and 1938.

[5] Mason, Charles F., Sheep Dips: Chem. Ind., vol. 44, No. 4, April 1939 (part 1), pp. 412, 414.
[6] American Society for Metals (Cleveland), Metals Handbook (1939 ed.): pp. 1394, 1554.

Range of quotations on arsenic and its compounds at New York (or delivered in East) 1937–38 [1]

	1937 (cents)	1938 (cents)
Arsenic metal, lump, cases per pound	42.00–43.00	40.00–41.00
White arsenic (As_2O_3), domestic, kegs, carlots do	3.00	3.00
Red arsenic (As_2S_2), imported, cases do	15.75–16.25	15.75–16.50
Calcium arsenate, wholesale, drums, carlots do	6.75	6.75– 7.25
Lead arsenate, wholesale, drums, carlots do	11.50	11.00–13.00
Sodium arsenate, wholesale, drums do	8.00	8.00
Sodium arsenite (liquid), works, drums per gallon	30.00–33.00	30.00–35.00

[1] As reported by Oil, Paint, and Drug Reporter.

The low quotations given in the table often are dealers' prices. Delivered prices for most arsenicals vary in different sections of the United States.

Throughout 1938 the London quoted prices for Mexican (99 percent As_2O_3) and Swedish (99.5 percent As_2O_3) white arsenic remained at £10 5s. to £10 15s. per long ton and for Cornish arsenic (99 percent As_2O_3) at the nominal price of £12 per ton.

FOREIGN TRADE

White arsenic imports in 1938 declined 26 percent compared with 1937, when imports were the highest ever recorded. Of the 1938 total, Mexico supplied 59, Sweden 20, France 8, Canada 5, Belgium 4, Japan 3, and Germany 1 percent. Imports from Mexico and Sweden decreased 27 and 42 percent, respectively, while those from France and Canada increased 42 and 15 percent, respectively.

Figures on imports of arsenical compounds other than white arsenic appear in the table of salient statistics. Imports of metallic arsenic in 1938 decreased 89 percent compared with those in 1937. Other percentage declines were: Arsenic sulfides 52, arsenic acid 92, calcium arsenate 50, sheep dip 19, paris green and London purple 5, and sodium arsenate 12 percent. All imports of metallic arsenic came from Germany and of calcium arsenate from Japan. Of the 241,602 pounds of arsenic sulfides imported, 144,622 came from Germany, 88,162 from Belgium, and 8,818 from France.

Official export data for white arsenic are not available, but reports of individual domestic producers indicate that about 2,300 tons were sold for export in 1938 compared with 2,200 tons in 1937. Exports of calcium and lead arsenate decreased 3 and 2 percent, respectively. Of the 5,242,882 pounds of calcium arsenate exported, 3,647,700 went to Peru, 1,040,308 to Colombia, 242,470 to Argentina, 75,964 to Mexico, and 65,500 to Chile. Of the 1,021,345 pounds of lead arsenate exported, 279,780 went to Argentina, 262,530 to the Union of South Africa, 122,104 to Chile, 107,561 to New Zealand, 61,716 to Cuba, and 42,280 to Mexico.

White arsenic imported for consumption in the United States, 1934–38, by countries

Country	1934		1935		1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Australia	39	$1,494	56	$2,334	690	$30,500				
Belgium	11	705	129	4,450	1,000	30,433	708	$20,373	565	$16,100
Canada	672	44,710	1,068	65,540	378	25,908	599	48,896	689	29,854
France	3,338	94,859	2,354	65,609	44	1,419	828	18,838	1,176	30,843
Germany	35	3,845	10	906	23	2,213	7	663	112	5,656
Japan	1,311	61,126	1,058	42,866	887	41,957	798	37,380	482	17,199
Mexico	8,704	500,970	9,274	525,140	8,174	426,590	11,500	556,097	8,422	415,180
Sweden			1,126	30,524	6,390	182,204	4,816	138,617	2,792	93,197
	14,110	707,709	15,075	737,369	17,586	741,224	19,256	820,864	14,238	608,029

WORLD PRODUCTION

The world output of refined and marketable crude white arsenic in 1938 is estimated at 55,000 metric tons, a decline of 4 percent compared with the 57,000 tons estimated for 1937. The decrease is attributed to the decline in smelter activity in Mexico and a few other countries. A substantial quantity of nonmarketable crude arsenic also is produced annually but is discarded or stored for future refinement. Accurate production data are not available, since some countries fail to record arsenic statistics and others report only on sales or exports. Virtually all the world arsenic output is a byproduct from the treatment of gold, copper, lead, zinc, cobalt, silver, tungsten, and tin ores, and this is greater than demand.

World production of white arsenic, 1934–38, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Australia:					
New South Wales	632	376	124		(2)
Western Australia	1,657	3,788	3,526	2,087	(2)
Belgium-Luxemburg Economic Union [3]	3,554	3,093	2,731	3,039	2,706
Brazil	700	696	732	717	519
Canada	747	1,161	619	630	987
China	1,206	1,200	(4)	(2)	(2)
Chosen	332	373	230		(2)
France	8,599	5,887	9,750	6,501	(2)
Germany [3]	2,752	5,508	2,739	2,852	2,845
Greece	149	167	85		(2)
Japan	2,734	3,161	2,629	(2)	(2)
Mexico	7,860	9,950	8,527	10,762	8,894
Portugal	40	73	186	21	1
Southern Rhodesia					19
Sweden (sales) [5]	7,405	6,350	8,647	(2)	(2)
United Kingdom	188	175	155	97	66
United States	11,880	12,916	13,952	15,253	15,136
	50,400	54,900	55,700	(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] Exports.
[4] Data not available. Estimate included in total.
[5] Arsenic content of ores mined is as follows: 1934, 28,618 tons; 1935, 24,418 tons; 1936, 23,312 tons; and 1937 20,954 tons.

Belgium.—Arsenic is a byproduct of the lead and zinc smelters of the Société Générale Métallurgique de Hoboken at Hoboken and of the Société Métallurgique d' Overpelt-Lommel at Overpelt. Of the 2,707 metric tons of white arsenic exported in 1938, 1,050 went to the United Kingdom, 632 to the United States, 255 to Argentina, 228 to Germany, 149 to Brazil, and 54 to the Union of South Africa.

Canada.—In 1938 Canada exported 1,378,300 pounds of arsenic (not otherwise specified) to the United States. Canada produces a granular variety of white arsenic used by the glass industry.

France.—Unconfirmed reports state that metallic arsenic recently began to be produced in France. French imports in 1938 included 18 metric tons of arsenic metal (21 in 1937) and 12 tons of white arsenic (21 in 1937); exports included 0.6 ton of arsenic metal (none in 1937) and 2,910 tons of white arsenic (4,245 in 1937).

Germany.—Bigot, Schaerfe & Co. Chemische Fabrik G. m b. H. at Hamburg produces metallic arsenic, much of which is exported. Imports of white arsenic totaled 617 metric tons in 1938 (557 in 1937). Of the 1938 imports, 312 tons came from Sweden, 215 from Belgium, and 89 from France; of the exports (2,845 tons) 514 tons went to Brazil, 335 to Turkey, 298 to the Netherlands, 288 to Denmark, 211 to Belgium, 178 to Spain, 173 to Argentina, and 144 to Hungary.

Mexico.—Arsenic and bismuth were among the commodities assessed the additional "export" tax, effective August 9, 1938. A production tax but not the regular export duty also is levied on these commodities. The new additional "export" tax amounts to 12 percent of the value as fixed by the commodity committee; in February 1939 the value placed on arsenic was 0.278 peso and on bismuth 11.343 pesos per gross kilo. The American Metal Co., Ltd., annually exports and distributes substantial quantities of white arsenic in the United States. Of the 8,854 metric tons of arsenic exported from Mexico in 1938 (10,695 in 1937), 8,424 tons went to the United States, 415 to the United Kingdom, and 15 to Germany.

Sweden.—Bolidens Gruv A.-B., the largest arsenic producer in the world, is constructing a number of round silos at Rönnskär for the storage of more arsenic. The company maintains a laboratory at Stockholm for research on new uses for arsenic and has achieved some success in the fields of insecticides, timber preservation, and corrosion-resistant concrete. A "Boliden impregnating salt" gradually is displacing imported creosote in Sweden and is used to preserve telephone poles, railroad ties, piles, mine timber, etc.

United Kingdom.—Imports of white arsenic totaled 4,359 long tons in 1937—2,211 tons from Sweden, 592 from Belgium, 564 from France, 448 from Mexico, and 100 from the United States.

BISMUTH

Data on the production of bismuth in the United States are lacking. Consumption probably remained about the same in 1938 as in 1937. As usual, pharmaceutical and alloy manufacturers consumed most of the bismuth. The use of bismuth and arsenical compounds in fighting venereal diseases increased. The price for bismuth metal advanced on April 25, 1938, from $1 to $1.05 in New York and from 4s. to 4s. 3d. per pound in London. In March 1939 the price was increased further to $1.10 and to 4s. 6d. per pound. Bismuth imports increased

37 percent in 1938, and unofficial data indicate that exports dropped sharply compared with 1937.

PRODUCTION

The producers of bismuth in the United States in 1938 were Anaconda Copper Mining Co., American Smelting & Refining Co., and United States Smelting, Refining & Mining Co. Bismuth also is imported and distributed in the United States by the Cerro de Pasco Copper Corporation from its properties in Peru.

CONSUMPTION

Lack of a complete report on domestic sales and of official data on exports of bismuth prevents accurate appraisal of the annual domestic consumption. Heretofore pharmaceutical and medicinal manufacturers have used about 75 percent and low-melting-point and nonshrinking alloys the rest of the total consumption.

Bismuth subcarbonate, subnitrate, and subgallate are a few of the many bismuth compounds used in indigestion remedies, salves, ointments, powders, and other medicinal preparations. According to the Census of Manufactures the production of bismuth subcarbonate increased from 231,432 pounds valued at $364,265 in 1935 to 247,609 pounds valued at $313,426 in 1937—a 7-percent increase in quantity and a 20-percent decrease in average value. Bismuth subnitrate output declined from 269,193 pounds valued at $360,303 in 1935 to 262,867 pounds valued at $309,678 in 1937—2 percent in quantity and 12 percent in average value. Production of bismuth subgallate increased from 24,328 pounds valued at $38,686 in 1935 to 40,861 pounds valued at $55,270 in 1937—a 68-percent increase in quantity and a 15-percent decrease in average value. Approximately 285,000 pounds of bismuth were consumed in the preparation of these three compounds in 1937. In recent years the consumption of bismuth subsalicylate, bismuth potassium tartrate, and other bismuth compounds for the treatment of venereal diseases has increased. These compounds have largely replaced the mercury compounds formerly used. Bismuth compounds are also employed in preparing patients for X-ray examination, and powdered bismuth is used in X-ray-proof rubber goods.

In the metallurgical field bismuth is used in low-melting-point and nonshrinking alloys of wide practical applications. The metal is employed in almost all low-melting metallic alloys used for fusible plugs, safety devices, dental models, soft solders, and tempering baths for small tools and pieces. The Cerro de Pasco Copper Corporation markets its alloy trade-marked Cerromatrix chiefly for permanent mountings for punch and die parts; Cerrobase, for use mainly as a master pattern metal in the foundry industry; and Cerrobend (Woods metal), for use largely as a filler in bending tubes and moldings. A number of other low-temperature-melting alloys also are available. The principal alloying components used with bismuth are lead, tin, and cadmium. The recently developed free-cutting aluminum alloy, 11S, contains a small percentage of bismuth. Bismuth also is used in small quantities in iron castings, in special brake linings, in enameling and the manufacture of optical glass, in the manufacture of special instruments, and in plastics as bismuth subnitrate.

PRICES

On April 25, 1938, the New York quoted price for bismuth metal was advanced from $1 to $1.05 per pound for ton lots, which was maintained the remainder of the year, according to Engineering and Mining Journal Metal and Mineral Markets. At the same time London quotations increased from 4s. to 4s. 3d. per pound. Late in March 1939, the domestic price was advanced further to $1.10 and the London price to 4s. 6d. per pound. Manufacturers of some bismuth compounds and salts reduced quotations slightly in February, but advanced them substantially in August and October 1938. According to the Oil, Paint, and Drug Reporter, the minimum price for bismuth subcarbonate increased from $1.23 at the beginning of 1938 to $1.53 per pound (fiber drums) at the end of the year, subnitrate from $1.13 to $1.33, and subgallate from $1.33 to $1.58, but the price for subsalicylate remained constant at $2.35 per pound.

FOREIGN TRADE

Bismuth metal imports in 1938 increased 37 percent over those in 1937. Of the 1938 imports, 91,728 pounds were from Peru and 570 from Canada. Imports of compounds, mixtures, and salts of bismuth decreased 36 percent in 1938. Of the bismuth compounds, etc., imported in 1938, 2,000 pounds were from Germany and 4 from the United Kingdom. In addition bismuth is imported as lead-bismuth alloy and in intermediate metallurgical products, statistical data for which are not available. Imports not valued chiefly for lead in 1938 totaled 779,155 pounds, including 626,830 pounds other than lead. This classification comprised imports from Belgium, the United Kingdom, Peru, and Germany. Of the 49,955 pounds from Peru, only 22,230 were lead; probably the balance was chiefly bismuth.

Official exports of bismuth metal are not recorded, but according to the Oil, Paint, and Drug Reporter shipments from Atlantic and Gulf ports totaled approximately 225,000 pounds in 1938 (about 900,000 in 1937). The bismuth was destined to ports in the United Kingdom and France. These figures doubtless include bismuth of foreign (shipments en route or from bonded warehouse) as well as of domestic origin.

Bismuth and "compounds, mixtures, and salts of bismuth" imported for consumption in the United States, 1934–38

Year	Bismuth		Compounds, mixtures, and salts of bismuth	
	Pounds	Value	Pounds	Value
1934	19,327	$19,927	305	$1,814
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

WORLD PRODUCTION

World byproduct-bismuth output is estimated at approximately 3,000,000 pounds annually. Europe consumes about 1,500,000 pounds of metal annually, chiefly in pharmaceutical and medicinal preparations. Most of the bismuth distributed in Europe is controlled by the world cartel. To base annual world consumption upon production and foreign trade of the metal is misleading, since the larger bismuth-refining plants seldom are operated until stocks of the metal become low, when metal is exported in large quantities. Consuming countries often import quantities adequate to supply demands for a long period. Likewise, the intermittent operation of bismuth-refining plants also makes it difficult to estimate production by individual years.

Official data on the total world production of bismuth are not available. The principal producing countries, in the probable order of importance, are as follows: United States, Peru, Mexico, Spain, Canada, Germany, and Japan. Virtually the entire world output is obtained as a byproduct in the treatment of lead, copper, silver, gold, tin, and tungsten ores. Most of the production probably is derived from the treatment of lead refinery slime. Byproduct production is greater than demand, and with the present price of bismuth it probably would be uneconomical to extract the metal from other than very high grade bismuth ores.

North America.—Mexico produced 409,612 pounds of bismuth in 1938 compared with 312,360 in 1937. Canadian bismuth output in 1938 totaled only 9,516 pounds compared with 5,711 in 1937 and 364,165 in 1936.

South America.—The bismuth metal output of Peru totaled 482,382 pounds in 1938 compared with 236,717 in 1937. Peruvian exports in 1938 included 454,657 pounds of refined bismuth in bars (196,132 in 1937) and 49,955 pounds of impure bismuth. The bismuth content of Bolivian exports totaled 42,316 pounds in 1938 compared with 67,942 pounds in 1937. Argentina also produces some bismuth ore.

Europe.—Spain doubtless will become an important factor in the world bismuth trade again, now that its civil war is ended. Of the 703,847 pounds of bismuth metal imported by the United Kingdom in 1937, 624,557 pounds were reported from the United States and 75,506 from Canada. Effective February 25, 1939, imports of both bismuth metal and alloy containing more than 50 percent bismuth and 15 percent lead by weight became duty-free. French metallic bismuth imports totaled 160 metric tons in 1938 compared with 40 in 1937. Bismuth is produced in the U. S. S. R. at the Chimkent (Central Russia) and Tetiukhe (Far East) lead works, and near Nerchinsk (Buriat-Mongol Republic) from tungsten-molybdenum ores.

Africa, Asia, and Australia.—The Union of South Africa produced 8,800 pounds of bismuth ore in 1938 (370 in 1937), chiefly from Cape Province. Bismuth carbonate occurs associated with tinstone and wolframite in Kigezi, Uganda, and in 1938, 930 pounds were exported.

Despite Sino-Japanese hostilities in South China in 1938, 52,120 pounds of bismuth ore were imported by devious routes into Hong Kong for export. Of the 51,454 pounds of bismuth ore exported from Hong Kong in 1938 (84,911 in 1937), 34,658 pounds went to the United Kingdom, 9,731 to Italy, 4,799 to Australia, and 2,266 to France.

Queensland, New South Wales, and Tasmania produced 20,160 pounds of bismuth ore in 1937.

MAGNESIUM

By Herbert A. Franke and M. E. Trought

SUMMARY OUTLINE

Increased interest in aircraft in the present national-defense program of the United States has again emphasized the growing importance of magnesium and other light alloys. Production (sales) of primary magnesium in the United States in 1938 was greater than ever before and exceeded that of 1937 by 6 percent. Consumption in industries other than aircraft and munitions probably dropped because of the downward trend in business activity in 1938. Statistics show a 4-percent decline in the use of magnesium structural and nonstructural products. The trend of total domestic consumption cannot be evaluated accurately owing to lack of data on stocks and exports. However, it appears that any decline in domestic consumption in 1938 was more than offset by sales to foreign consumers.

The 10-percent decline in the production of magnesium structural products probably was due to a pronounced drop in the manufacture of portable and high-speed equipment which was offset only partly by larger consumption in the aircraft industry. Considerable magnesium is used annually as a deoxidizer in the metallurgical industry and as a component of aluminum and other alloys, but the quantity so used probably decreased in 1938. The quoted nominal price of magnesium at New York remained unchanged at 30 cents per pound throughout 1938 but was reduced to 28 cents per pound in March 1939.

Outside of the United States production of magnesium increased at an even more rapid rate. World output totaled possibly 22,000 metric tons, an increase of 22 percent over that indicated for 1937. Germany continued as the outstanding producer, with an estimated output of 12,000 tons. Consumption also has advanced more rapidly in Germany, the United Kingdom, and other European countries than in the United States, particularly with regard to structural products used in airplanes, automobiles, and other transportation facilities. The rapid growth in the use of magnesium abroad is due to the armament and self-sufficiency programs of totalitarian and democratic countries as well as to development of new uses based upon its lightness and strength.

PRODUCTION

Sales of primary magnesium in the United States in 1938 totaled 2,410 short tons and thus established a new record. The Dow Chemical Co. of Midland, Mich., supplied the entire output. As heretofore the metal was produced by the electrolysis of magnesium chloride derived from undergound brine.

Because magnesium is classed as an essential material by the Army and Navy Munitions Board and because interest in national defense is high, the accompanying historical table is presented, which shows the quantity of domestic magnesium sold or used since 1915, when the industry was inaugurated. Prior to that time metallic magnesium was imported from Germany. The number of domestic producers dropped from five during the World War to two in 1920. In 1927 the American Magnesium Corporation ceased producing primary ingot, and since then the Dow Chemical Co. has been the sole producer and has supplied virtually all domestic requirements. Imports have been of little consequence since 1922. Exports of magnesium have been relatively large since 1933, but official data thereon are not available.

Magnesium sold or used by producers and imported into the United States, 1915–38

Year	Sold or used by producers [1]		Imports for consumption [2]	
	Pounds	Value	Pounds	Value
1915	87,500	$440,000	(3)	(3)
1916	75,400	311,462	(3)	(3)
1917	115,813	233,626	(3)	(3)
1918	284,118	615,217	[3] 11,899	[3] $16,259
1919	127,465	247,302	13,239	13,583
1920	123,800	233,200	29,275	25,055
1921	48,000	86,000	39,913	30,592
1922	[4] 60,000	[4] 89,000	182,939	54,448
1923	[4] 125,000	[4] 155,000	13,974	11,576
1924	[4] 128,000	[4] 150,000	8,738	6,561
1925	245,000	274,400	8,326	7,070
1926	322,650	390,400	10,117	4,750
1927	366,400	441,700	7,131	8,402
1928	530,782	289,658	12,039	11,890
1929	908,351	512,313	3,490	6,539
1930	559,631	268,864	5,689	19,599
1931	580,463	199,633	2,454	2,580
1932	791,699	228,653	935	1,049
1933	1,434,893	377,181	575	734
1934	4,249,838	(5)	661	962
1935	4,241,218	(5)	884	1,292
1936	3,903,312	(5)	1,126	1,479
1937	4,539,980	(5)	1,321	1,727
1938	4,819,617	(5)	60	188

[1] 1915–27: Metallic magnesium (ingots, castings, alloys, ribbon, powder, rods, tubes, sheets, etc.); 1928–38: New ingot magnesium.
[2] Includes alloys and scrap (magnesium content).
[3] Not separately recorded prior to July 1918.
[4] Estimated.
[5] Bureau of Mines not at liberty to publish figures.

Figure 1 shows trends in magnesium production and prices since 1915.

CONSUMPTION

Lack of complete and official data on stocks and exports of magnesium prevents an accurate appraisal of annual domestic consumption. However, the substantial increase in exports indicated by unofficial data compared with the moderate increase in sales, the general recession in business conditions, and the falling off in production of manufactured magnesium products suggest that domestic consumption decreased in 1938.

Of outstanding interest in recent years is the trend in consumption of magnesium-rich alloys used as structural materials. Their use increased nearly 500 percent from 1932 to 1938, inclusive, despite a slight decrease in 1938. The 10-percent drop in consumption of structural products in 1938 compared with 1937 is ascribed to lower activity in the portable and high-speed equipment industries. The

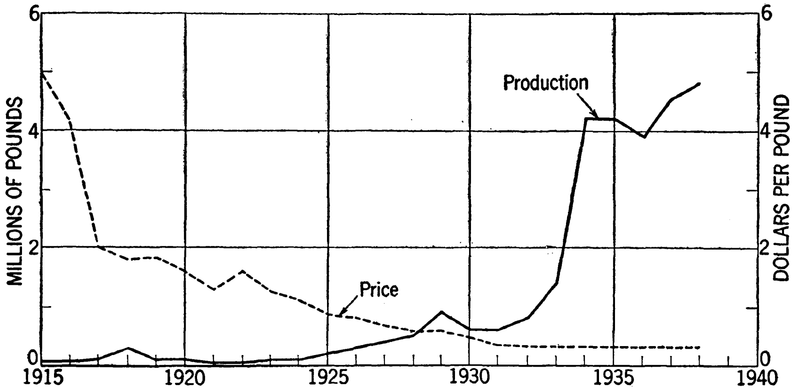

FIGURE 1.—Trends in quoted price and production of magnesium in the United States, 1915–38.

use of magnesium structural products in aircraft gained, and in 1939 and 1940 consumption in this industry is destined to be the greatest in history. The advance in consumption of nonstructural products in 1938 is attributable partly to the increased manufacture of pyrotechnics. The use of magnesium as a scavenger and deoxidizer in the metallurgical industry and as a component in aluminum and other alloys probably declined in 1938.

The following table shows the magnesium sold or used by domestic fabricators of magnesium metal and magnesium-rich alloys. Total manufactures of structural and nonstructural products decreased 4 percent from 1937 to 1938, and production of alloy ingot dropped 40 percent. Of the structural products, sales of sheet gained 6 percent, while sales of castings declined 10 percent, sales of structural shapes, rods, and tubing 8 percent, and those of forgings 81 percent. The 83-percent increase in the manufacture of total nonstructural products in 1938 is slightly exaggerated, as some products classified as "Wire and ribbon" were included under "Structural shapes, rods, and tubing" in 1937. Sales of ribbon decreased slightly.

The value of magnesium castings averaged $1.31 per pound in 1938 compared with $1.17 in 1937.

Magnesium products (other than ingot and stick magnesium) manufactured in the United States and sold or used by the companies manufacturing the products 1936–38

[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	1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value
Alloy ingot	872,020	(1)	1,257,479	(1)	756,000	(1)
Structural products:						
Castings	791,859	$939,806	1,180,190	[2] $1,375,884	1,067,310	$1,392,882
Sheet	51,798	38,474	118,284	74,924	124,930	79,764
Structural shapes, rods, and tubing	[3] 71,242	[3] 82,532	[3] 86,954	[3] 94,250	80,206	49,972
Forgings	59,710	40,061	31,939	18,568	5,924	6,541
Other structural	1,031	2,469	1,024	1,797	----------	----------
Total structural products	975,640	1,103,342	1,418,391	[2] 1,565,423	1,278,370	1,529,159
Nonstructural products:						
Wire and ribbon	[3] 875	[3] 3,065	[3] 811	[3] 3,020		
Shavings	37,917	18,838	[4] 59,354	[4] 26,042	184,223	259,256
Powder	27,594	49,732	[4] 40,502	[4] 75,110		
Total nonstructural products	66,386	71,635	100,667	104,172	184,223	259,256
Grand total (exclusive of alloy ingot)	1,042,026	1,174,977	1,519,058	[2] 1,669,595	1,462,593	1,788,415

[1] Bureau of Mines not at liberty to publish figures.
[2] Revised figures.
[3] Some products formerly classified as "Wire and ribbon" are included under "Structural shapes, rods, and tubing."
[4] Minor quantities of shavings included under "Powder"; separate figures not available.

A list of magnesium fabricators in the United States in 1938 follows:

Louis Allis Co., 427 East Stewart Street, Milwaukee, Wis.

American Foundry Equipment Co., 400 South Byrkit Street, Mishawaka, Ind.

American Magnesium Corporation, Gulf Building, Pittsburgh, Pa. (Plant at 2210 Harvard Avenue, Cleveland, Ohio.)

Bohn Aluminum & Brass Corporation, 1400 Lafayette Building, Detroit, Mich. (Plant at 3516 Hart Avenue, Detroit, Mich.)

Detroit Pattern Plate Co., 6304 Epworth Boulevard, Detroit, Mich.

Delco Products Division of General Motors Corporation, 329 East First Street, Dayton, Ohio.

Doehler Die Casting Co., 386 Fourth Avenue, New York, N. Y. (Plant at Batavia, N. Y.)

Dow Chemical Co., Midland, Mich.

Eclipse Aviation, Division of Bendix Aviation Corporation, 1265 McBride Avenue, Little Falls, N. J. (Plant at West Paterson, N. J.)

Fremont Flask Co., Fremont, Ohio.

H. L. Harvill, Inc., 2344 East 38th Street, Los Angeles, Calif.

Hills-McCanna Co.,[1] 2353 Nelson Avenue, Chicago, Ill.

Hoover Co., North Canton, Ohio.

Madison-Kipp Corporation, Madison, Wis.

Magnesium Fabricators (Division of Bohn Aluminum & Brass Corporation), East Maumee Street, Adrian, Mich.

Magnesium Products, Inc.,[1] Los Angeles, Calif.

Pyle Pattern & Manufacturing Co., 1137 Sanford Street, Muskegon Heights, Mich.

Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland, Ohio.

Springfield Bronze & Aluminum Co., Springfield, Mass.

Wellman Bronze & Aluminum Co., 6017 Superior Avenue, Cleveland, Ohio.

[1] Commenced fabrication in 1939.

Westinghouse Electric & Manufacturing Co., Cable Avenue, East Pittsburgh, Pa.
Wright Aeronautical Corporation, 132 Beckwith Avenue, Paterson, N. J.

New fabricators in 1938 were Fremont Flask Co., Madison-Kipp Corporation, and Magnesium Fabricators. The latter manufactures Magalloy X alloys (formerly trade-marked Bohnalite X). The alloys manufactured by the Dow Chemical Co. are trade-marked Dowmetal and those of the American Magnesium Corporation are known as AM Alloys.

The aircraft industry continued to increase its consumption of magnesium alloys in 1938, particularly sand and die castings. In airplane engines, magnesium castings were employed for crankcases, blower sections, accessory housings, pump bodies, rear sections, diffuser plates, and many miscellaneous parts. In the fuselage the metal was employed in landing and tail wheels, cockpit fittings, pedals, doorframes, levers, housings, and other secondary structural parts and interior appointments.[2] Sand castings weighing more than 300 pounds are used in some airplanes. The use of magnesium in aircraft is receiving more attention because the saving in weight means increased pay load, reduced power consumption, and improved performance. Experimental applications of sheet and shapes for cowling, fairings, and other secondary parts of planes are said to be successful. The aircraft defense program of the United States, the large foreign orders for airplanes, and the increased application of lighter structural parts are expected to increase magnesium consumption significantly in 1939 and 1940.

Magnesium structural products also are employed in portable tools, packaging machinery, vacuum cleaners, portable typewriters, optical instruments, small sewing machines, electric-motor fans, cameras, textile equipment, foundry flasks, and many other articles of portable and high-speed equipment. The textile field offers many opportunities for the use of magnesium products.

PRICES

The nominal New York price for 99.8-percent ingot magnesium remained unchanged at 30 cents per pound, carload lots, throughout 1938, according to the Engineering and Mining Journal Metal and Mineral Markets. Quotations for less than carload lots, 100 pounds or more, were 32 cents per pound, with a premium of 5 cents a pound over ingot price for specified stick sizes (¼, ⅜, ½, 1, and 2 pounds each). Late in March 1939 the domestic price was reduced 2 cents, to 28 cents per pound for ingots in carload lots and to 30 cents per pound for 100-pound lots or more. The four-notched ingots commonly furnished are 4 by 4 by 28 inches and weigh approximately 17 pounds. Alloy ingot normally is quoted at 3 cents per pound more than pure magnesium ingot.

London quotations for magnesium in 1938 ranged from 1s. 5d. to 1s. 6d. per pound for ingot and stick and from 2s. 9d. to 5s. 6d. per pound for powder, according to grade and specification.

[2] Winston, A. W., Magnesium Alloys and Their Use in Aircraft: Paper presented before Aeronautical Sess., Western Metal Cong., Los Angeles, March 1938. Sutton, H., Light Alloys for Aircraft: Iron Age, vol. 143, No. 13, Mar. 30, 1939, pp. 30, 92.

FOREIGN TRADE[3]

Although official export data on magnesium are not separately recorded, published information[4] indicates that a substantial quantity of the magnesium produced in the United States in 1938 went to Japan, the United Kingdom, and other European countries. Magnesium imported in 1938 comprised only 60 pounds of sheets, tubing, ribbons, etc., valued at $188. Imports in 1937 were 1,321 pounds of powder valued at $1,727. Of the 1938 imports, 48 pounds were from the United Kingdom and 12 from Germany.

TECHNOLOGIC DEVELOPMENTS

Perhaps the greatest development during 1938 was the method devised to protect magnesium alloys from corrosion. The Dow Chemical Co. announced a caustic (sodium hydroxide) pressure treatment that produces a dense, adherent, abrasion- and corrosion-resistant film on the metal surface. The coating was designed primarily for the decorative treatment of small parts, such as die castings, as the film may be dyed a wide variety of colors as it is being formed. Its resistance to salt-water corrosion is said to be good. A process developed for the treatment of sand castings is claimed to afford protection superior to that of any other known method. It consists of a hydrofluoric acid dip followed by immersion in a boiling water solution of sodium dichromate. Another treatment for sand castings has been approved by the Navy Bureau of Aeronautics as an alternate for the PT-13 anodizing process. It includes surface cleaning, a dip in hydrofluoric acid followed by a boil in a solution of ammonium sulfate and sodium dichromate, and a seal by boiling in an aqueous solution of arsenous oxide. Paint is used as a final step in all methods of protecting the surface of magnesium alloys. A zinc chromate primer meeting Navy specification P-27 provides maximum protection and exhibits satisfactory adhesive qualities.[5] Navy specification and proprietary finishes based on glyceryl phthalate and phenol-formaldehyde resins give good results outdoors and in corrosive atmospheres, and lacquer type materials are satisfactory indoors. Research is being conducted on the reduction of iron and copper impurities in magnesium alloy to improve corrosion resistance. All these developments are expected to advance the use of magnesium alloy in saline, humid, and heavy industrial atmospheres.

The protective-treatment process for magnesium alloys invented by Sutton, Le Brocq, and Savage (British Patent 493,935) also is receiving wide recognition. The metal is treated by electrolysis in a solution of chromic acid and various other salts.

High-strength alloys for extrusions and forgings were studied intensively during 1938. A material has been produced experimentally, which has an ultimate strength exceeding 60,000 pounds per square inch and a yield strength of 50,000 pounds per square inch. As a result of development work in the forging field, magnesium alloys can be hot-pressed into more intricate shapes and larger pieces than

[3] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[4] Oil Paint and Drug Reporter. Exports from U. S. Ports: 1938.
[5] Gross, W. H., Cleaning and Painting Magnesium Alloys: Metal Cleaning and Finishing, vol. 10, No. 8, August 1938, pp. 554-556, 558, 562, 570.

before. Research also has produced new casting and extrusion alloys with higher mechanical properties and corrosion resistance. A new die-casting alloy, Dowmetal R, is characterized by increased toughness and improved castability compared with Dowmetal K. It consists of 8.5 to 9.5 percent aluminum, 0.13 percent manganese, 0.4 to 0.8 percent zinc, and the remainder magnesium. Considerable research is being done in the United States and the United Kingdom [6] on the addition of silver to magnesium alloy. The results indicate a combination of high-yield strength with good ductility and no loss of corrosion resistance.

Low-grade magnesite ore can be concentrated by flotation methods developed by the Metallurgical Division of the Bureau of Mines.[7] The metal can be produced from concentrates either by the electrolysis of $MgCl_2$ obtained by chlorination or by reducing the calcined concentrates with carbon in an electric arc furnace at a temperature of about 2,000° C. In the latter process, originally developed in Austria, the metallic vapor formed is chilled suddenly as it leaves the furnace, and the condensate (consisting of metal powder, oxide, soot, and other impurities) is separated from the gaseous products. The metal is distilled from this product in a second furnace. The Bureau of Mines has made a substantial contribution to the solution of some of the unusual and difficult problems involved in this process.

The Northwest Magnesite Co. completed construction of a 5-ton (daily) experimental plant at Chewelah, Wash., in the fall of 1938 for the beneficiation of waste magnesite ores by flotation. This work suggests the possible future utilization of magnesite for the production of magnesium with cheap power generated at Bonneville and Grand Coulee.

The use of sea water and bittern as a source of magnesia for metal manufacture in the United States was recently suggested.[8]

The occurrence, production, and properties of magnesium are given in a recent German publication.[9] British magnesium foundry practice includes the addition of bentonite and iron oxide to the silica sand mold.[10] Surface rolling has been found effective in improving the fatigue strength of magnesium-alloy parts (e. g., aircraft propellers) which are subjective to erosion action.[11] Numerous United States patents have been granted recently in connection with magnesium production processes (Nos. 2,144,339, 2,134,969, 2,132,408, 2,123,990, 2,122,435, 2,147,645, 2,148,358, and 2,111,661), treatment methods, alloys, etc. British Patents 465,097 and 487,836 describe the thermal reduction of dolomite to magnesium using silicon or ferrosilicon and a small quantity of cryolite or other fluoride. Powdered magnesium can be used in the form of porous compacts for pyrotechnics.[12]

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[6] Engineer (London), Magnesium Alloys: Applications and Future Development: Supplement, Feb. 24, 1939, pp. 8–11.

[7] Doerner, H. A., and Harris, Dwight L., Concentration of Low-Grade Magnesite Ores by Flotation: Washington State College, State Electrometallurigical Res. Lab., Bul. P. 1, Pullman, June 1938, 30 pp.
Magnesium from Magnesite Ores of the Pacific Northwest: Progress Reports—Metallurgical Division, No. 25: Bureau of Mines Rept. of Investigations 3419, Oct. 1938, pp. 32–37.

[8] Manning, Paul D. V., Magnesium Metal and Compounds: Chem. and Met. Eng., vol. 45, No. 9, September 1938, pp. 478–482.

[9] Gmelin's Handbuch der anorganischen Chemie: Pt. A, Secs. 1 and 2, 8th ed., 1937, pp. 156 and 222.

[10] Devereux, W. C., Magnesium Foundry Practice: Iron Age, vol. 142, No. 25, Dec. 22, 1938, pp. 25–27. (Originally published in Foundry Trade Jour., vol. 59, Sept. 22, 1938.)

[11] Sachs, G., Improving Aircraft Propellers by Surface Rolling: Metals and Alloys, vol. 10, No. 1, January 1939, pp. 19–23.

[12] Light Metals, Compacted Magnesium Flares: Vol. 1, No. 8, September 1938, p. 279.

WORLD PRODUCTION

Despite the continued increase in consumption of magnesium in recent years, official data on world production are still lacking owing to the fact that only estimates are available for all countries except the United States. It is estimated that the world produced 22,000 metric tons of magnesium in 1938 compared with 18,000 tons in 1937. The 1938 estimate by individual countries in tons is as follows: Greater Germany, 12,000; United Kingdom, 2,200; United States (sales), 2,186; Japan, 2,000; France, 1,800; Switzerland, 800; U. S. S. R., 600; and Italy, 400. The magnesium chloride electrolytic process continued to supply the greater part of the output. The principal raw materials used were potash final liquor, carnallite, magnesite, and brine. It is expected that a larger part of the output will be furnished by the thermal reduction process in 1939 when new plants in the United Kingdom, Japan, and Italy are scheduled to begin production. These new plants will use magnesite and dolomite as raw material. Since 1934 the number of producing countries has doubled, and the number of metal reduction plants has increased from 7 to 17. Before the end of 1939 probably more than five additional plants will be in operation.

Canada.—Reports state that the production of magnesium is contemplated in British Columbia and Quebec. The Consolidated Mining & Smelting Co. of Canada, Ltd., is conducting research on an electrothermic magnesium process.

France.—The production of magnesium is estimated at 1,800 metric tons in 1938 compared with about 1,500 tons in 1937. Although the three producing plants now use imported magnesite, dolomite could be utilized by making a few changes in the process. The reduction plant at Jarrie (Isère) was expanded considerably in 1938. During 1938 French imports of magnesium and its alloys totaled 159 tons (67 tons in 1937).

Germany.—Despite the set-back of the German magnesium industry in 1937 due to decreased exports, output in 1938 is estimated at 12,000 metric tons. At the end of 1937 about 6,000 tons of metal were in stock, but it was expected that domestic consumption would gain 5,000 to 6,000 tons in 1938 owing to measures taken to replace imported metals with magnesium. The automobile industry increased its consumption of magnesium alloys from 170 tons in 1936 to 1,400 in 1938, or 724 percent, by replacing aluminum and tin structural parts. This industry is expected to consume 2,500 tons of magnesium alloy annually in the near future. Magnesium alloys are employed in street cars and in place of copper-zinc alloys in the manufacture of engraving plates. The metal is also used for bus bars, switch installations in telephone apparatus, optical parts, measuring instruments, and similar equipment. The highly destructive German-made aerial bomb used in Spanish Civil War raids on Barcelona consisted of ammonium nitrate, powdered charcoal, and aluminum, enclosed in a magnesium-alloy shell. Germany has adequate magnesium-fabrication facilities, as only 40 percent of the foundry and 20 to 30 percent of the milling capacity was utilized in 1937.

The I. G. Farbenindustrie A. G., Bitterfeld, the leading producer, is supplementing potash end-liquor raw material with increasing quantities of Austrian magnesite. The metal is derived from the electrolysis of magnesium chloride at a temperature of 700° C. The Wintershall A. G., Heringen, on the Werra River uses carnallite as raw material and produces about 1,000 tons of metal annually by electrolysis. The former cost of producing magnesium ingot in Germany (1,835 RM. per metric ton) is believed to have been reduced in 1938. The Austrian Magnesite Co. and Steirische Magnesit A. G. are constructing a new 200-ton capacity (annual) magnesium plant at Radenthein in Kärnten, Austria. These companies own extensive and high-grade magnesite reserves in the Veitsch Valley, Steiermark, Austria, which have added materially to Germany's already adequate raw-material sources for magnesium.

Data upon magnesium exports in 1938 are not available, but they are believed to have been considerably less than in 1936, when approximately 3,400 tons were shipped to the United Kingdom, Czechoslovakia, and Italy.

Italy.—Magnesium is produced by the Società Anonima Magnesio Italiano Sulcis near St. Giovanni, Sardinia, by the electrolysis of magnesium chloride derived from domestic dolomite. Both Società Anonima per il Magnesio e le Leghe di Magnesio and Montecatini are constructing magnesium plants at Bolzano, which expect to begin operations in 1939. Apparently the former concern will reduce dolomite in an electric furnace in the presence of an iron catalyst and then condense the magnesium vapor by a special process.

Japan.—Although the production of magnesium in Japan has advanced greatly, published information indicates that it was necessary to import about 600 metric tons of metal from the United States alone in 1938 to supply demands. The Japanese output of magnesium in 1938 is estimated at 2,000 tons. Companies producing metal included the Nichiman Magnesium Co., Ltd., the Japan Magnesium Metal Co., Ltd., the Asahi Electro-Chemical Industry Co., Ltd., and the Japan Soda Co., Ltd. The first concern plans to increase its capacity from 900 to 1,500 tons of magnesium annually, which will make the total capacity of the four companies 4,220 tons. Both magnesite and sea water are used as raw materials, and both the thermal reduction and magnesium chloride electrolytic processes are employed. Metal production is planned by the Kwanto Electro-Chemical Co., Chosen Riken Metals Co., Japan Magnesium Co., Shinetsu Nitrogen Co., Manchurian Magnesium Manufacturing Co., Oriental Metal Industrial Co., and others. The Manchurian Magnesium Manufacturing Co. plans to build a plant in Yingkow and to use magnesite from Tashihchiao and magnesium chloride from salt works on the Gulf of Liaotung. The nationalization of the electrical industry in Japan is expected to result in the extension and consolidation of magnesium-producing companies and entrance into the field by power and aluminum companies.

United Kingdom.—British magnesium output in 1938 is estimated at 2,200 metric tons, although one source reports the output as 7,000 tons. The two British magnesium producers, Magnesium Elektron, Ltd., Clifton Junction,[13] and Magnesium Metal & Alloys, Ltd., Rainham, Essex, extended the productive capacity of their plants in 1938. Magnesium Elektron, Ltd., planned to utilize British dolomite instead of imported magnesite by the end of 1938.[14] The other concern is continuing development work on its thermal reduction process employing calcium carbide as the reducing agent. The new plant

[13] Light Metals, British Magnesium Production: Vol. 1, No. 6, July 1938, pp. 193–196.
[14] Ball, C. J. P., The Magnesium Industry in Great Britain: Light Metals, vol. 1, No. 3, April 1938, pp. 79–81.

of the Magnesium Metal Corporation at Port Tennant, Swansea, England, was scheduled to begin production early in 1939. The Lancashire Metal Subliming Corporation, which is erecting a new magnesium works at St. Helens, Lancashire, reported the satisfactory operation of its pilot plant. Early in 1939 the International Alloys, Ltd., announced construction of another magnesium plant, near Cardiff, South Wales, to be operated by the Cardiff Corporation. As a result of the armament program there was a considerable expansion in magnesium fabrication facilities in the United Kingdom in 1938.

British imports of magnesium and its alloys in 1938 totaled 1,637 metric tons compared with 2,265 tons in 1937. Of the 1938 imports, 1,362 tons were from Germany, 208 from the United States, 46 from France, and 21 from Switzerland. The decline in imports indicates the effect of the growing domestic output of magnesium. Only 16 tons of metal were exported in 1938.

Yugoslavia.—A Yugoslav firm is experimenting with the production of magnesium metal from magnesite, large deposits of which occur near Maglaj, Uzice, and Vucitru and along the Vardar River.

ANTIMONY AND CADMIUM

By E. W. Pehrson and John B. Umhau [1]

SUMMARY OUTLINE

ANTIMONY

The world antimony market in 1938 was influenced mainly by two factors—the slump in industrial activity in the United States and the curtailment of supplies from China. The net effect on prices was a substantial recession from the unusually high levels of 1937.

In the United States apparent consumption dropped 36 percent; but the decrease in actual consumption was less severe, as producers' and consumers' stocks were reduced during the year. Production of antimony contained in antimony ores fell 49 percent and supplied less than 6 percent of the total apparent consumption. Imports comprised only 59 percent of the quantity received in 1937; 84 percent of the antimony imported in 1938 was in the form of ore. Mexico continued to be the chief source of supply, but Bolivia increased in relative importance at the expense of Mexico. Imports of regulus totaled only 821 short tons and were the lowest in over 50 years.

Quotations for Chinese metal during 1938 trended downward despite the threatened shortage of supply, and published prices apparently were nominal for most of the year. Quotations for American metal remained more or less independent of those for Chinese metal, the average for the year being 12.35 cents per pound compared with 15.35 cents in 1937. Heretofore, American brands usually were priced 0.25 to 0.50 cent below Chinese brands, but in 1938 the differential averaged 2.24 cents. The quotation for Chinese 99-percent metal averaged 14.59 cents in 1938 and 15.30 cents in 1937.

Ore supply to the smelter at Laredo, Tex., was adequate throughout 1938, although the plant was shut down from April 25 to September 24. Finished products on hand were ample to meet customers' reduced requirements at all times. Antimony oxide was in greater demand than the metal during 1938. A new source of antimony

[1] Figures on imports and exports (except as otherwise indicated) compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.

metal in the United States is the Los Angeles plant of the Menardi Metals Co., which began to produce antimony in 1938. The plant treats a mixed mercury-antimony concentrate imported from Mexico. The American Smelting & Refining Co. is said to be considering antimony production at its Perth Amboy plant, but no output was reported for 1938.

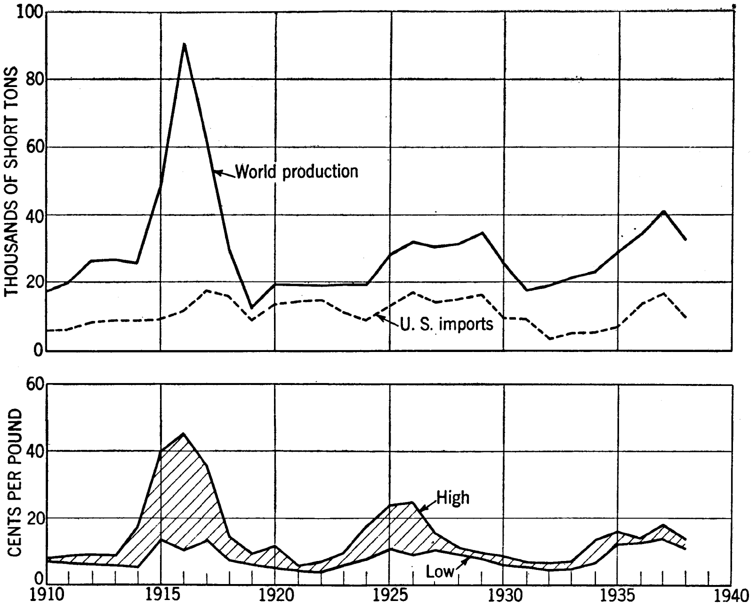

FIGURE 1.—Trends in world production, United States imports, and New York price of antimony, 1910–38.

World production was about 20 percent lower in 1938 than in 1937 (see fig. 1). Production in China (exports) declined 47 percent, whereas output in Bolivia, also measured by exports, increased 32 percent and was the highest on record. Bolivia thus attained first rank in antimony production in 1938. Mexico produced 24 percent less and fell from second to third place in world output.

Salient statistics for antimony in the United States, 1934–38

	1934	1935	1936	1937	1938
Production of antimony ore and concentrates......short tons..	897	3,616	3,867	4,250	2,730
Antimony contained......do....	404	559	755	1,266	650
Antimony content of antimonial lead produced from domestic and foreign ores......short tons..	1,675	1,136	1,471	1,726	2,080
Secondary antimony produced......do....	7,550	9,600	9,900	12,340	8,500
Imports for consumption:					
Antimony in ore......do....	2,891	4,587	10,545	13,818	8,322
Needle or liquated antimony......do....	417	1,352	1,185	772	90
Metal......do....	1,765	1,248	1,171	1,043	821
Oxide......do....	269	594	1,201	1,118	414
Exports of foreign antimony......do....	402	318	392	437	711
Primary antimony available for consumption......do....	7,262	8,351	15,040	18,132	11,557
Stocks of antimony in bonded warehouse at end of year short tons..	570	830	443	649	337
Average price of antimony at New York: [1]					
Chinese......cents per pound..	8.92	14.08	12.97	15.30	14.59
American......do....	(2)	13.62	12.25	15.35	12.35
World production......short tons..	24,900	32,700	38,000	41,100	[3] 32,500

[1] According to American Metal Market. [2] Data not available. [3] Estimated.

Throughout the year lines of communication between the antimony-producing centers and exporting points in China were harassed by Japanese activities in South China; and after the fall of Canton in October 1938 shipments from the mines virtually ceased, although exports from stocks at Hong Kong continued. Total exports for the year were the lowest since 1919, and for the first time in over 30 years China yielded first place in world output.

National defense.—Because antimony is an important industrial raw material and the United States depends largely on foreign sources of supply, this metal is one of 10 mineral commodities classified as strategic by the Army and Navy Munitions Board. Prior to 1931 the United States obtained a very large part of its antimony imports from China—in 1929, as much as 70 percent. Since this oversea supply could be cut off by a hostile fleet in time of war and since industry would be handicapped seriously if deprived of antimony, our situation at that time was highly unsatisfactory from a national defense viewpoint. In 1931, however, the strategic position was improved materially by establishment of an antimony smelter at Laredo, Tex., to treat Mexican antimony ores, and since that time Mexico has become the principal source of antimony for the United States. Meanwhile Bolivia also has increased its shipments of antimony ores to this country, so that at present the United States obtains a very large part of its antimony from sources in the Western Hemisphere. In 1938 over 85 percent of the total imports were purchased in Mexico and South America.

Notwithstanding this improved strategic position as to antimony there has been agitation for accumulation of a reserve stockpile in the United States, to be used if and when foreign supplies are cut off in a war emergency. The need for this precaution has been emphasized recently by events in Mexico and Bolivia which not only have increased the costs of producing antimony and thus retarded development of resources in those countries but also have threatened the free flow of ores to the United States. In this connection the anticipated passage of the Thomas bill (S. 572—76th Congress) by the Congress of the United States is significant. This bill provides $100,000,000 for the purchase of stockpiles of strategic commodities over a period of 4 years. In addition, the bill authorizes $500,000 to be expended annually for 4 years by the Bureau of Mines and the Geological Survey in investigating domestic resources of deficient strategic minerals. As of June 1, 1939, the bill was awaiting final approval by the Senate and House of Representatives.

Domestic antimony resources.—The development of a domestic antimony industry would be the most desirable method of overcoming our dependence on foreign sources of supply. Unfortunately, however, the known resources in the United States offer little hope of achieving that objective. This is evident from the accompanying historical record of production, consumption, and price of antimony in the United States from 1910 to 1938, which shows that under the stimulus of exceptionally high prices during the World War production in 1915 reached a peak of 4,900 tons, or about 35 percent of domestic requirements in that year. The following extracts from a report on strategic minerals recently prepared by the Bureau of Mines and the Geological Survey corroborate the foregoing conclusion:

Sources.—Several antimony-bearing minerals are found in many metalliferous deposits that are exploited largely for lead, copper, silver, and gold, and this antimony is finally recovered in the ordinary processes of smelting and treatment. Deposits that contain only stibnite (antimony sulfide), the principal source of antimony, are uncommon. This mineral is commonly found in tabular veins and even though these persist downward in the earth, experience in mining shows that the shoots of antimony sulfide are sporadic and largely confined to shallow surficial zones. For these reasons, the appraisals of reserves of antimony minerals are highly speculative unless the deposits are thoroughly explored.

Production, imports, exports, apparent consumption, and prices of antimony in the United States, 1910–38

Year	Production [1] (short tons)	Imports [2] (short tons)	Exports [3] (short tons)	Apparent consumption (short tons)	Average price [4] (cents per pound)	Wholesale price index [5] (1913=100)	Antimony index price [6] (cents per pound)
1910	1,598	5,890	(7)	7,488	7.27	100.9	7.21
1911	1,543	6,193	(7)	7,736	7.48	93.0	8.04
1912	1,224	8,505	(7)	9,729	7.63	99.0	7.71
1913	2,204	9,086	(7)	11,290	7.43	100.0	7.43
1914	2,530	9,035	(7)	11,565	8.53	97.6	8.74
1915	4,900	9,408	(7)	14,308	29.52	99.6	29.64
1916	2,547	11,999	(7)	14,546	25.33	122.5	20.68
1917	2,244	17,683	(7)	19,927	20.73	168.3	12.32
1918	1,557	16,052	50	17,559	12.55	188.1	6.67
1919	[8] 1,943	9,061	(7)	11,004	8.16	198.6	4.11
1920	[8] 2,033	13,763	------------	15,796	8.38	221.2	3.79
1921	[8] 1,589	14,730	------------	16,319	4.92	139.8	3.52
1922	1,258	15,605	------------	16,863	5.42	138.5	3.91
1923	1,841	11,417	------------	13,258	7.81	144.1	5.42
1924	1,852	9,234	13	11,073	10.77	140.5	7.67
1925	1,972	13,446	19	15,399	17.50	148.3	11.80
1926	2,289	17,084	44	19,329	15.91	143.3	11.10
1927	1,996	14,208	28	16,176	12.34	136.7	9.03
1928	2,105	15,281	51	17,335	10.30	138.5	7.44
1929	2,311	16,273	57	18,527	8.94	136.5	6.55
1930	1,302	9,741	174	10,869	7.67	123.8	6.20
1931	768	9,737	107	10,398	6.72	104.6	6.42
1932	878	3,518	124	4,272	5.62	92.8	6.06
1933	870	5,421	270	6,021	6.51	94.4	6.90
1934	1,657	5,775	170	7,262	8.92	107.3	8.31
1935	1,110	7,492	251	8,351	13.62	114.6	11.88
1936	1,434	13,830	224	15,040	12.25	115.8	10.58
1937	1,636	16,720	224	18,132	15.35	123.6	12.42
1938	1,871	9,897	211	11,557	12.35	112.6	10.97

[1] Includes only antimony recovered in antimonial lead made from domestic antimony and lead ores. Does not include relatively small quantity recovered in other alloys and in compounds, for which data are not available. Antimony contained in domestic antimony ores produced in the United States, most of which was used in producing antimonial lead, was as follows: 1915, 2,100 tons mainly from California, Nevada, and Alaska; 1916, 1,770 tons mainly from Nevada, California, and Alaska; 1917, 390 tons mainly from Nevada; 1918, 50 tons; 1922, 4 tons; 1923, 10 tons; 1924, 33 tons; 1925, 33 tons; 1926, 43 tons; 1928, 42 tons; 1932, 419 tons of which 416 were from Idaho; 1933, 587 tons all from Idaho; 1934, 404 tons all from Idaho; 1935, 559 tons mainly from Idaho; 1936, 755 tons of which 729 were from Idaho; 1937, 1,266 tons of which 768 were from Idaho and the remainder principally from Alaska; and 1938, 650 tons of which 379 were from Idaho and the remainder principally from Alaska.

[2] Includes metal, antimony content of ores, and estimated content of needle or liquated antimony, antimony compounds, type metal, antimonial lead, and other alloys.

[3] Exports under drawback.

[4] 1910, Metal Statistics 1918, p. 365; 1911–38, Metal Statistics 1939, p. 493.

[5] Based on price indexes of U. S. Department of Labor.

[6] Average price divided by wholesale price index.

[7] Data not available.

[8] Includes foreign antimony used at domestic smelters, probably only a small part of the total.

For many years, China has been the source of 50 to 70 percent of the world's supply of antimony, but important sources exist in Mexico, Czechoslovakia, Bolivia, and France. China was the principal source of imports into the United States for many years, but since 1930 has given place to Mexico, which in recent years has contributed 60 percent of domestic imports, mostly in the form of ore. Numerous antimony deposits have been explored in the United States, but the principal sources are a few districts in Idaho, Nevada, California, and Alaska; most of these have been studied and reports on them are available.

Production from domestic mines.—The trend in production of metallic antimony in the United States has been determined by conditions at mines (such as the size, grade, and accessibility of the deposits), by the smelting facilities available, and by prevailing prices. As the smelting of antimony ores is not a complicated operation, small smelters have been installed at several mines, but sources of domestic ore large enough to justify construction of a large smelter have not yet been found. Since 1910, annual production has fluctuated widely, largely in response to changes in price. The largest smelter in the United States was erected at Laredo, Texas, to smelt ores from Mexico, and these have since formed the main contribution to domestic supply.

One district in Inyo County has been the principal source of ore in California, but this has been idle since the war, although other deposits have since been discovered and developed nearby. Several districts in Idaho, notably the Yellow Pine, in Valley County, have been noteworthy sources and seem to be capable of increased production at prices slightly higher than those recently prevailing. In Nevada, deposits containing notable amounts of stibnite have been explored at many places, but only a few have been able to ship ore in recent years. Apparently somewhat higher prices would be needed to insure continuous production. Other sources have been explored in Arkansas, Montana, Washington, and Alaska, but the production has been small and intermittent. At high prices, some deposits in the interior of Alaska could become important sources.

A review of the period from 1914 to 1919 shows an abrupt rise, then a steady decline of production in close response to rise and decline of prices. When this record is considered with operations at producing centers, it seems clear that most of the deposits were not physically exhausted but were unable to compete at prevailing prices.

Estimates of probable yield of domestic antimony follow:

Potential production of antimony in the United States at assumed index prices of 10, 20, and 30 cents per pound, in short tons

Assumed index price per pound (cents)	Potential production		
	First year	Second year	Third year
10	1,000-1,500	1,000- 1,500	1,000- 1,500
20	2,500-3,500	3,000- 5,000	4,000- 6,000
30	5,000-7,500	6,000-10,000	8,000-12,000

Technologic progress.—There are no large low-grade disseminated deposits of antimony now known in the United States; therefore, it would appear that even though there was a decided improvement in the technology of the recovery of antimony it could not be applied commercially to the domestic resources.

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 1938, antimonial lead containing 1,871 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 1938 totaled only 650 tons—49 percent below that in 1937. The decline was due to reduced outputs at the Meadow Creek mine in the Yellow Pine district, Idaho, and the Stampede mine, Kantishna district, Alaska.

The Meadow Creek mine produced concentrates containing 379 tons of antimony in 1938 compared with 754 tons in 1937. The concentrates are largely ferruginous and in addition to antimony contain gold and silver. The product is shipped to the lead smelter at Midvale, Utah. On August 1, 1938, the Bradley Mining Co. took over the assets of the Yellow Pine Co., former operators of the mine. The Stampede mine operated by Morris P. Kirk & Son, Inc., produces a 50- to 55-percent concentrate which is shipped to alloy plants in the United States. Other producers for whom production or shipment of antimony was reported in 1938 included Meyers & Craig, Yreka district, Shoshone County, Idaho; Nevada Antimony Mines, Inc., from the Bloody Canyon mine, Pershing County, Nev.; and J. H. Caustin and Jack Flynn, Lovelock, Nev. The Menardi Metals Co., Los Angeles, Calif., purchased a small quantity of antimony ore from various unnamed producers in California. Statistics on the domestic output of antimony ores and concentrates and the antimony content thereof during the past 5 years are given in the salient statistics table. A large part of the antimony ore produced in the United States is charged to lead furnaces and recovered as antimonial lead.

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, Los Angeles, Calif. In May 1938 the press reported that the American Smelting & Refining Co. expected to start production of metallic antimony at its Perth Amboy plant, but no production of regulus was reported by the company for 1938.

Production of the Laredo plant from 1933 to 1937 was shown on page 648 of Minerals Yearbook, 1938. Data for 1938 are not available for publication.

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 antimonial lead production at primary lead refineries are shown in the accompanying table. These represent only part of the total 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, 1934–38, in short tons

Year	Production	Antimony content				
		From domestic ores	From foreign ores [1]	From scrap	Total	
					Quantity	Percent
1934	16,607	1,657	18	588	2,263	13.6
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

[1] Includes lead ores, antimony ores, and metallic antimony.

Secondary production.—The production of secondary antimony in the United States in 1938 totaled 8,500 tons, compared with 12,340 tons in 1937. Statistics for the past 5 years are shown in the salient statistics table. Additional information is given in the chapter in this volume on Secondary Metals—Nonferrous.

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, 1934–38, in short tons [1]

	1934	1935	1936	1937	1938
Domestic antimony recovered in antimonial lead	1,657	1,110	1,434	1,636	1,871
Imports for consumption (antimony content):					
Antimony ore	2,891	4,587	10,545	13,818	8,322
Needle or liquated [2]	292	946	830	540	63
Compounds [3]	241	502	975	909	336
Type metal, etc	586	209	309	410	355
Regulus	1,765	1,248	1,171	1,043	821
Total available	7,432	8,602	15,264	18,356	11,768
Exports under draw-back	170	251	224	224	211
Available for consumption	7,262	8,351	15,040	18,132	11,557

[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 1938 declined 36 percent from 1937. This decrease, however, exaggerates the actual decline in the use of antimony in manufactured products, as consumers probably drew on stocks of raw materials accumulated during 1937 when a threatened shortage of Chinese antimony caused prices to rise to extraordinary levels. One of the principal uses of antimony is in the manufacture of storage batteries. According to the American Bureau of Metal Statistics 92,000 tons of antimonial lead were used for this purpose in 1938 compared with 107,060 tons in 1937. The antimony content of this material ranges from 4 to 12 percent, and while 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 extensive use of antimony is in the manufacture of babbitt metals employed in bearings. These are applied widely in automotive equipment, although cadmium-silver bearings have been used extensively in this field during the last few years.

The use of antimony in the manufacture of chemicals declined 37 percent in 1938 compared with 1937. In 1938, 4,393 tons of oxides and other compounds with an estimated antimony content of 3,539 tons were produced, whereas in 1937 (revised figures), 6,992 tons (5,667 content) were made. Figures for the 3 preceding years are as follows: 1936, 4,852 tons (3,940 content); 1935, 3,969 tons (3,227 content); and 1934, 2,569 tons (2,101 content). Foreign ores are used largely in the manufacture of antimony chemicals. The principal compound made is the oxide, which is employed extensively as a pigment in sanitary enamelware. In recent years the addition of antimony oxide pigment to nitrocellulose enamels has been gaining.

FOREIGN TRADE

The following tables show imports and exports of antimony and antimony products.

Antimony imported for consumption in the United States, 1934–38

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						
1934	8,455	2,891	$158,672	417	$26,761	1,765	$158,414	301	$35,507
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

Antimony imported for consumption in the United States, 1937–38, by countries

Country	Antimony ore			Antimony metal	
	Gross weight (short tons)	Antimony content		Short tons	Value
		Short tons	Value		
1937					
Argentina [1]	1,536	981	$114,190		
Belgium				60	$12,247
Bolivia [1]	1,678	1,047	169,710		
Canada				(2)	226
Chile [1]	2,892	1,707	282,770		
China	251	128	17,260	466	88,224
France				73	16,980
Japan	28	17	2,688		
Mexico	34,736	9,110	1,047,625	415	100,453
Peru	1,267	792	136,088		
United Kingdom	65	36	4,680	29	10,355
	42,453	13,818	1,775,011	1,043	228,485
1938					
Argentina [1]	1,101	715	69,931		
Belgium				25	5,009
Bolivia [1]	1,880	1,133	159,407		
Chile [1]	1,201	776	127,156		
China	70	43	4,571	661	118,199
France				11	2,260
Japan				(2)	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

[1] Imports credited to Argentina and Chile originate largely in Bolivia.
[2] Less than 1 ton.

Estimated antimony content in type metal, antimonial lead, and other alloys imported for consumption in the United States, 1934–38, in short tons [1]

Year	Type metal and antimonial lead	Other alloys [2]	Total	Year	Type metal and antimonial lead	Other alloys [2]	Total
1934	18	568	586	1937	[3] 17	393	410
1935	89	120	209	1938	[3] 59	296	355
1936	[3] 56	253	309				

[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, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	402	$42,415	1937	437	$86,991
1935	318	62,167	1938	711	96,836
1936	392	56,308			

In addition to the foreign exports reported above 211 tons of antimony were exported in 1938 in manufactures (chiefly storage batteries) under the draw-back provisions of the tariff law; 224 tons were so exported in 1937. Stocks of needle and liquated antimony and regulus on hand in bonded warehouses amounted to 337 tons at the end of 1938 compared with 649 tons on December 31, 1937.

PRICES

The downward trend in prices evident at the close of 1937 continued in 1938. The average spot quotation for domestic metal (99.5 percent) in New York was 12.35 cents per pound in 1938 compared with 15.35 cents in 1937. Prices were stable at 13.75 cents throughout the first quarter of the year, but in the latter part of April the market began moving to lower levels as the volume of business continued small. The low for the year—10.75 cents—prevailed the latter part of July and most of August, but as business improved in late summer quotations advanced, reaching 12.25 cents on October 20. This price was maintained until early December, when a temporary slackening in demand forced prices down to 11.25 cents. As the year closed the market became firmer, and the quotation on December 31 stood at 11.75 cents.

Quotations for prompt Chinese metal (99 percent), as reported by the American Metal Market, were maintained at considerably higher levels than those for domestic antimony. The average for 1938 was 14.59 cents, duty paid, which was 2.24 cents above the average for American brands. In previous years the differential seldom had exceeded 0.50 cent per pound. However, one authority stated that it was doubtful if the actual sales price of Chinese metal in 1938 averaged more than 0.25 to 0.50 cent above that of American brands.[2]

On the London Metal Exchange quotations for English brands declined from £81–82 per long ton on January 1, 1938, to £70–71 on July 1, which price was maintained for the rest of the year. Foreign

[2] Henderson, H. P., Review of Antimony Market for 1938: Metals, vol. 9, No. 7, January 1939, pp. 13–15.

regulus (in warehouse) was quoted at £63–66 on January 1, £46–48 on July 1, and £52–53 at the close of the year. In China the basis for quotations was changed several times during the year, so that a reliable picture of the trend of prices is not available. The market at Hong Kong was affected by the Sino-Japanese hostilities, and prices trended downward. At the beginning of the year the quotation was £58 per long ton but dropped to £40 in June, July, and August. During the last 4 months of the year the trend was upward, and at the end of the year the quotation was £43.[3]

Average monthly quoted prices of antimony, prompt delivery at New York, 1934–38, in cents per pound [1]

Month	Chinese brands (duty paid)					American brands [2]			
	1934	1935	1936	1937	1938	1935	1936	1937	1938
January	7.21	14.36	12.96	14.14	15.56	14.11	12.74	14.14	13.75
February	7.17	14.50	13.05	14.69	15.74	14.25	12.99	14.55	13.75
March	7.54	14.50	13.42	16.92	15.75	14.25	13.07	16.37	13.75
April	7.92	14.30	13.50	16.79	15.65	14.04	12.67	16.02	13.65
May	8.49	13.91	13.50	14.79	14.46	12.73	12.41	14.79	12.46
June	7.89	12.75	13.20	14.70	13.94	12.50	11.72	14.70	11.73
July	8.02	12.75	13.00	14.79	14.00	12.50	11.24	14.81	11.02
August	8.52	12.93	12.57	15.53	14.00	12.50	11.12	15.34	10.88
September	8.76	13.54	12.50	(3)	14.00	13.22	11.76	16.59	11.32
October	9.39	15.62	12.50	(3)	14.00	15.34	12.07	16.92	12.06
November	12.38	15.30	12.50	15.91	14.00	14.19	12.21	15.87	12.25
December	13.81	14.54	12.93	14.69	14.00	13.84	12.95	14.12	11.56
Average	8.92	14.08	12.97	15.30	14.59	13.62	12.25	15.35	12.35

[1] Source: Metal Statistics, 1939, pp. 487, 495.
[2] No quotations published prior to 1935.
[3] No average due to lack of offerings during greater part of month.

Quotations for antimony ore on January 13, 1938, were reported as follows by Engineering and Mining Journal Metal and Mineral Markets: "Per (short-ton) unit of antimony contained, $1.50 @ $2.00, f. o. b. New York. London, per long-ton unit, 5s. 6d. @ 6s. 3d. for 60- to 65-percent sulfide ore." By August 4, New York quotations had declined to $1.20 @ $1.30 per short-ton unit for 50- to 55-percent ores, $1.35 @ $1.40 for 58- to 60-percent ores, and $1.60 @ $1.70 for 60- to 65-percent ores. London prices for 60- to 65-percent ores were 5s. 3d. @ 5s. 6d. per long-ton unit. At the close of the year the respective prices were $1.20 @ $1.25, $1.30 @ $1.40, $1.40 @ $1.60, and 6s. 3d. @ 6s. 6d.

WORLD PRODUCTION

World production of antimony in 1938 is estimated at 29,500 metric tons, a decline of about 20 percent from the output in 1937. As measured by exports, production in China dropped 47 percent, and for the first time in many years that country ranked second in world output. Exports from Bolivia increased 32 percent and were the highest on record. Bolivia thus assumed first place in world antimony production, whereas Mexico, with a 24-percent decline in output, dropped from second to third place. Bolivia, China, and Mexico produced 29, 26, and 25 percent, respectively, of the world antimony supply in 1938; the United States produced less than 2 percent.

[3] Donovan, Howard, American consul, Hong Kong, March 27, 1939.

World production of antimony, 1934–38, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
North America:					
Canada				[2] 18	34
Honduras		5	1	(3)	(3)
Mexico [4]	2,455	4,204	6,719	9,788	7,391
United States	337	466	630	1,056	543
South America:					
Argentina				31	(3)
Bolivia [5]	1,891	3,376	6,040	6,556	8,682
Peru	92	288	696	848	384
Europe:					
Czechoslovakia	928	1,944	829	997	(3)
France	232				(3)
Germany (Austria)			100	200	(3)
Greece	73	29	159		(3)
Italy	249	369	333	414	(3)
Portugal			20	49	131
Yugoslavia		75	600	579	1,100
Asia:					
Borneo, British		16	30	4	(3)
China [6]	15,548	17,700	16,348	14,702	7,797
Chosen		2	14	8	(3)
India, British		8	33	24	(3)
Indochina		16	38	4	(3)
Japan	26	47	110	(3)	(3)
Turkey (Asia Minor)	27	103	457	536	(3)
Africa:					
Algeria	529	810	983	778	744
Morocco:					
French		179	88	22	125
Spanish	247		[5] 12	158	93
Southern Rhodesia			68	64	63
Union of South Africa		4	15		18
Oceania:					
Australia:					
New South Wales	10	24	45	70	(3)
Queensland			4	(7)	7
Victoria		5	94	145	195
Western Australia				[8] 245	(3)
New Zealand					1
	22,600	29,700	34,500	37,300	[8] 29,500

[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] Data not available.
[4] Includes antimony content of antimonial lead.
[5] Exports.
[6] Figures represent antimony content of regulus, crude antimony, and oxide exported.
[7] 434 kilos.
[8] Estimated.

REVIEW BY COUNTRIES

Argentina.—According to American Vice Consul Robert E. Wilson, of Buenos Aires, the only antimony mine being worked in November 1938 was a property known as El Pabellon situated in the Cerro Granados, Department of Rincanada, Province of Jujuy. Approximately 50 metric tons of sulfide and oxide concentrates were produced in 1937, and during the first 8 months of 1938, 200 tons of oxide ore containing 60 percent antimony were produced. The mine has not been developed sufficiently to permit an estimate of its worth. The National Lead Co. produces about 15 tons of byproduct antimony each year at its lead smelter at Puerto Vilelas (Chaco).

Canada.—The new antimony refinery of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, B. C., was completed and put into operation during the last quarter of the year. The plant treats 10 short tons of silver-refinery byproducts daily, from which about 4 tons of antimony are recovered. No production for 1938 was reported officially. Imports of antimony totaled 428 tons in 1938 and 588 tons in 1937.

China.—Rail movement of antimony from Changsha to Hong Kong via Canton, initiated the latter part of 1937 after the Yangtze River was closed to commerce, continued in 1938 despite frequent bombings from Japanese airplanes. However, in October Japanese activity in the vicinity of Canton closed the shipping route to Hong Kong, and subsequently shipments from Changsha were diverted to Haiphong, French Indochina, via Kweilin. In March 1939 Howard Donovan, American consul at Hong Kong, reported that antimony shipped via Haiphong would begin to arrive in Hong Kong within 2 or 3 months.

With the general reorganization of the Chinese Government on January 1, 1938, the Hankow Foreign Trade Office and the Antimony Administration at Changsha, both subsidiary to the Natural Resources Commission, were removed from the control of the Military Affairs Commission and placed under jurisdiction of the Ministry of Economy. The Hankow Foreign Trade Office continued to exercise strict control over the sale and exportation of antimony products, although no attempt was made to "squeeze" out private traders. Because of diversion of antimony trade from Hankow to Hong Kong, the price quotations of the Foreign Trade Office were made in Hong Kong currency beginning in May 1938, and early in June the office was moved to Hong Kong.

The usual excellent statistical reviews supplied by Vice Consul Robert M. Taylor from Hankow were received for the first 9 months of 1938, but he was unable to obtain any information after the Japanese occupation of Hankow in late October. A Reuter dispatch from Shanghai dated November 28, 1938, stated that the Japanese intended to press on to the antimony mines and to establish a Japanese antimony monopoly. However, as of May 1939 the mines were still under Chinese control. Unofficial data indicate a decline in production from 8,850 long tons for the first 9 months of 1937 to 7,565 for the same period in 1938. Shipments from Changsha to Hong Kong fell successively in the first three quarters of 1938, and all excess stocks were moved from Hunan Province to Hong Kong in anticipation of the Japanese invasion. On September 30 total stocks in the Hunan consular district were estimated at 837 tons, mostly at Changsha. Collective prices for regulus paid by the Antimony Administration at Changsha ranged from ch \$560 to \$580 per long ton (U. S. \$140 to \$145) during the first quarter of 1938. Similar data for the second and third quarters are not available, but from October 10 to 20 the published quotation was ch \$436.

Exports for all of 1938 were reported officially as follows: Crude 535 long tons, oxide (etc.) 253 tons, and regulus 7,070 tons; for 1937 the figures were 2,220 tons, 602 tons, and 12,322 tons, respectively.

Germany.—The antimony mines at Neustift near Schleiming (Austria), idle in 1937 and 1938, were being reopened early in 1939, apparently with Government aid. Germany's recent conquests have not improved her antimony position, as Austria depended largely on imported metal, and Czechoslovakia's production only equaled local requirements. Germany imported 3,643 metric tons of antimony metal in 1938 and 2,672 tons in 1937.

Japan.—Little information is available on the progress made in the various projects to increase Japan's antimony production mentioned in Minerals Yearbook, 1938. Presumably local deposits have not equaled expectations, as a trade report in August 1938 stated that a Japanese concern had arranged to import 200 metric tons of antimony ore per month from Bolivia.

Mexico.—A unique source of antimony is the deposit of livingstonite, a rare mercury-antimony sulfide ($HgS.2Sb_2S_3$), in the Huitzuco district, Guerrero. The crude ore is treated by flotation, and the concentrate is shipped to the plant of the Menardi Metals Co., Los Angeles, Calif., where both refined mercury and antimony are produced.[4] In 1937, 30,184 short tons of ore with an average content of 1.25 percent antimony and 0.315 percent mercury were produced, and from January 1 to November 30, 1938, 46,822 tons, averaging 0.96 percent antimony and 0.24 percent mercury, were treated. In the latter part of 1938, 3 to 4 tons of concentrate containing 25 to 30 percent antimony and 7 to 11 percent mercury were being produced daily.

In August 1938 a 12-percent export tax was imposed on virtually all products shipped from Mexico. The tax presumably was designed to give the Government the benefits accruing to exporters from depreciation in the foreign exchange value of the peso. It is levied on the basis of an official valuation of commodities established monthly; in the case of metals and ores, one value apparently applies to all products regardless of the form in which they are exported and notwithstanding the fact that low-grade ores are less valuable per unit of metal than high-grade products. The tax thus has tended to be unduly burdensome on the producers of low-grade antimony ores, shipments of which are said to have been curtailed sharply in 1938.

Yugoslavia.—The Podrinje Consolidated Mines, Ltd., completed its modernized smelter, which now has an annual capacity of 1,800 tons of antimony. Another smelter is reported to have been completed at the Zajaca mine near Loznica, owned by Montania A. G.

CADMIUM

In 1938 the cadmium industry experienced one of the worst years in its history. In contrast to the extraordinary demand and ascending prices in the 3 previous years, consumption fell abruptly and prices collapsed. At the close of the year the New York quotation for commercial sticks was 60 cents per pound compared with official quotations of \$1.25 and reported sales of prompt metal at \$2.00 during the acute shortage in the summer of 1937. According to trade reports the domestic price situation was aggravated further by the 50-percent reduction in the import duty (from 15 to 7.5 cents per pound), effective January 1, 1939, negotiated in the trade agreement with Canada signed November 17, 1938.

The statistical record indicates a 34-percent decline in apparent consumption of cadmium in all forms, but sales of metal by domestic producers to domestic consumers dropped 54 percent. Imports

[4] Vaupell, C. W., Mercury Deposits of Huitzuco, Guerrero, Mexico: Mining Technology, A. I. M. E., vol. 1, No. 5, September 1937, 14 pp.
Segura, David, Metallurgy of the Huitzuco Mercury Ores: Metals Technology, A. I. M. E., vol. 5, No. 2, February 1938, 7 pp.
Menardi, H. B., Reduction of Livingstonite Concentrate: Metals Technology, A. I. M. E., vol. 6, No. 2, February 1939, 8 pp.

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declined 97 percent, and for the first time large exports were reported to the Bureau of Mines. The decline in consumption may be ascribed in part to the 48-percent reduction in automobile production, one of the principal outlets for cadmium as a constituent of bearing metals. According to a well-informed authority, there was a 50-percent decline in this use of cadmium during 1938. Undoubtedly substitutes for cadmium plating, developed during the period of high prices, made additional inroads on the cadmium market in 1938, and consumption of cadmium compounds was much lower.

Despite the sharp reduction in demand, production of cadmium held up remarkably well in 1938. The total output decreased only 13 percent, production of metal 6 percent, and that of compounds (cadmium content) 48 percent. There were two new producers of metallic cadmium in 1938. Figures on production and sales for 1937 and 1938 reveal that producers' stocks of metal at the end of 1938 totaled at least 1,750,000 pounds.

World production, estimated at 4,200 metric tons in 1938, was virtually unchanged from 1937. Declines in the United States, Australia, Canada, and South-West Africa were offset by gains in Belgium, Germany, Poland, and probably Italy. London prices declined steadily throughout the year.

Cadmium produced, sold by producers, imported, and consumed in the United States, 1934–38, in pounds

Year	Produced: Metallic cadmium	Produced: Cadmium compounds (estimated content)	Produced: Total cadmium	Metallic cadmium sold by producers	Metallic cadmium imported	Apparent consumption
1934	2,777,384	566,700	3,344,000	2,472,971	125,955	3,470,000
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

[1] Of this quantity 458,283 pounds were exported.

DOMESTIC PRODUCTION

The cadmium production shown in the foregoing table includes metal derived from domestic and foreign raw materials 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 1938 Mexico reported shipments of crude materials to the United States containing 838 tons of cadmium compared with approximately 683 tons in 1937.

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 a period of 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 in 1937 and 1938 production was limited to some extent to that derived from current zinc operations. A more severe decline in output in 1938 was avoided by new plants coming into production and the increased imports of crude materials from Mexico. New producers of metallic cadmium in 1938 included the Henryetta (Okla.) smelter of the Eagle-Picher Mining & Smelting Co. and the Josephtown (Pa.) plant of the St. Joseph Lead Co. A cadmium dust-recovery plant was completed late in 1937 at the Fort Smith (Ark.) zinc smelter of the Athletic Mining & Smelting Co. The dust is shipped to the East St. Louis plant of the American Zinc Co. of Illinois for conversion. There were no new producers of cadmium compounds in 1938.

A list of producers of both metal and compounds in 1936 was published on page 742 of Minerals Yearbook, 1937. To this should be added the American Steel & Wire Co., Donora, Pa., a new producer of refined cadmium in 1937, and the two new producers in 1938 mentioned above.

A small but increasing quantity of secondary cadmium is recovered from scrap resulting from the manufacture of automobile bearings. This is not included in the statement of production, as it would represent duplication of metal previously reported.

Since the zinc concentrates of the Tri-State region constitute the largest potential source of cadmium in the United States, the following information on the cadmium content of ores from this district is of interest. (The data have been obtained through the courtesy of the Tri-State Zinc and Lead Ore Producers Association.) One series of tests on ores from the various camps in the district indicated an average cadmium content of 0.40 percent for coarse concentrates (30 samples), 0.31 percent for sludge (9 samples), and 0.36 percent for flotation concentrates (48 samples). The content did not vary appreciably between the various parts of the district. An analysis by L. T. Merrill, of the Picher Assay Office, of a sample from 7 tons of sample rejects collected in 1930 gave the following results:

	Percent		*Percent*
Zinc	58. 000	Lime	0. 670
Iron	1. 700	Magnesia	. 508
Lead	1. 520	Silica	4. 990
Copper	. 060	Carbon dioxide	1. 081
Cadmium	. 387		
Sulfur	30. 837		99. 753

In 1937 the district produced 446,890 tons of zinc concentrates which, at an average cadmium content of 0.37 percent, contained approximately 3,300,000 pounds of cadmium. Probably less than one-fourth of this amount actually was recovered in 1937, indicating that a substantial increase in production from this source is possible should market conditions warrant the necessary investment in plant and equipment.

DOMESTIC CONSUMPTION

The statistical trends in consumption during 1938 have been discussed in the summary at the beginning of the cadmium section of this chapter.

One of the principal uses of cadmium is in bearing metals for high-speed internal-combustion engines. Consumption for this purpose has been estimated at approximately 1,000,000 pounds in 1937 and 500,000 pounds in 1938. According to an authority in the trade, during 1938 there were additional users of cadmium bearings, and all former consumers continued to employ them. As stated in Minerals

Yearbook, 1938, some difficulty has been experienced from corrosion of cadmium alloys by lubricants, and several methods of overcoming it have been developed. J. G. Ryan (U. S. Patent 2,116,851, May 10, 1938) states that the addition of 0.1 to 5.0 percent antimony to cadmium-silver alloys improves their resistance to corrosion.

Several articles relating to the uses of cadmium were published recently. Alloys were discussed by Wilson and Wick[5] and Monselise.[6] Erskine[7] has described methods for coloring cadmium electrodeposits, and Rinker[8] and others[9] discussed electroplating technique. Two United States patents (Nos. 2,115,080 and 2,134,055) were issued during 1938 on processes for making cadmium red pigments.

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 before 1938, but the quantities involved are believed to be relatively unimportant. In 1938, however, there was considerable exportation of cadmium metal. Reports to the Bureau of Mines indicate that four companies shipped 458,283 pounds abroad in 1938. Exports of cadmium with benefit of draw-back, mostly in lithopone, totaled 36,081 pounds in 1938 and 23,508 in 1937. Imports of metallic cadmium decreased very substantially in 1938, being only 22,582 pounds compared with 828,535 in 1937. Of the 1938 total, Belgium supplied 20,067 pounds; Italy, 2,240; Poland, 220; and Germany, 55. Of the quantity received in 1937, Canada supplied 270,620 pounds; Belgium, 250,878; United Kingdom, 139,405; Norway, 76,940; Germany, 34,562; Poland, 27,557; Australia, 22,400; France, 3,968; and Netherlands, 2,205. The average value of the cadmium imported in 1938, as reported by the Customs Bureau, was $1.35 per pound compared with $1.30 in 1937 and $0.71 in 1936. The United States also imports crude materials containing cadmium for refining. Shipments of this type of material from Mexico to the United States during 1938 contained 838 tons of cadmium compared with 683 tons in 1937.

PRICES

According to Engineering and Mining Journal Metal and Mineral Markets, the average price of cadmium in 1938 was 98.0 cents per pound compared with $1.223 in 1937, 97.8 cents in 1936, 70.5 cents in 1935, and 55 cents from 1932 to 1934. In 1929 the price ranged from 80 to 95 cents per pound. Incomplete data obtained from producers by the Bureau of Mines indicate that the average value realized on sales of metallic cadmium in 1938 was 75 cents per pound compared with $1.14 in 1937, 80 cents in 1936, and 50 cents in 1935.

[5] Wilson, Curtis L., and Wick, Oswald J., Cadmium-Indium Alloy System: Ind. and Eng. Chem., vol. 29, October 1937, pp. 1164–1166.
[6] Monselise, G. G., Cadmium Alloys and Their Applications: Chim. et ind., vol. 20, 1938, pp. 201-203.
[7] Erskine, William J., Coloring of Cadmium: Met. Ind. (New York), vol. 37, No. 3, March 1939, p. 123.
[8] Rinker, E. C., Cadmium on Steel: Steel, vol. 104, No. 5, January 30, 1939, pp. 44–46.
[9] Camel, Leroy, Method and Composition for Cadmium Plating: U. S. Patent 2,143,760, January 10, 1939.
Cadmium vs. Zinc Plating: Met. Ind. (New York), vol. 36, No. 11, p. 510, November 1938.

At the beginning of 1938 patented shapes for platers were quoted at $1.35 per pound, New York, and producers' minimum price for quantity business in commercial sticks was $1.00. With production maintained at fairly high levels and consumption waning, stocks began to accumulate and prices weakened. On April 1 both quotations were reduced 15 cents per pound, and subsequent cuts in August and September brought prices down to 65 cents for commercial sticks and 95 cents for platers' shapes. On November 24 a further reduction to 60 and 85 cents, respectively, was announced. This was attributed by the trade to the Canadian Trade Agreement signed on November 17, under which the United States import duty on cadmium was reduced from 15 to 7.5 cents per pound, effective January 1, 1939. No change in quotations was made during the remainder of the year.

At the close of the year, Engineering and Mining Journal Metal and Mineral Markets (December 29, 1938, p. 3) issued the following statement regarding publication of monthly average cadmium prices during 1939:

> In addition to the monthly average price of cadmium that we have been publishing for the last 9 years, a monthly average will be established in 1939, beginning with January, on the price quoted by producers on ordinary commercial shapes, quantity business.
>
> The old average, accepted in the industry as representing the average of the producers' and platers' quotations, will be continued because several contracts have been made on that basis.
>
> Confusion over cadmium quotations has obtained for a number of years, largely because of the numerous changes that have occurred in reference to new outlets for the metal. Platers market a fairly large poundage at a premium over the producers' quotations, delivering patented shapes and servicing the process used in plating as well. Not so many years ago the platers virtually dominated the market because of the large proportion of the metal that was consumed in the plating industry. Since 1936, however, the automotive industry has found extensive use for cadmium in the production of bearings for internal-combustion motors. The price situation appears to be clearing, and we find that a need now exists for a straight producer's quotation.

According to Quin's Metal Handbook, London quotations (listed as nominal) declined steadily throughout 1938 from 5s. 2.5 d. ($1.30) per pound on January 1 to 2s. 1d. (48.0 cents) on December 31. During the first 5 months of 1938 London prices exceeded or approximately equaled New York quotations, but for the remaining months quotations in London were approximately 7 to 12 cents under the domestic market.

WORLD PRODUCTION

Statistics from countries that produced 86 percent of the total output in 1937 indicate that world production of cadmium in 1938 was virtually the same as in 1937. The United States contributed 45 percent of the estimated total for 1938, some of which was from imported crude materials. Declines were noted in the outputs of Australia, Canada, and South-West Africa, as well as in the United States, whereas Belgium, Germany, and Poland achieved substantial increases. Italy probably produced more cadmium in 1938 than in 1937, but statistics thereon are not available at this time.

World production of cadmium, 1934–38, by countries, in kilograms

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Australia (Tasmania)	172,588	222,108	251,826	210,608	185,121
Belgium	160,076	150,999	203,997	271,000	[1] 479,700
Canada	133,179	263,323	356,484	338,018	317,122
France	66,000	121,000	84,000	99,000	(2)
Germany	14,000	167,000	302,000	355,000	432,000
Italy	8,345	16,360	54,630	90,850	(2)
Japan	[3] 1,800	3,236	23,563	(2)	(2)
Mexico	(4)	(4)	(4)	(4)	(4)
Norway	137,324	118,335	101,876	154,192	(2)
Poland	143,557	120,700	140,900	124,461	182,591
South-West Africa	63,500	145,150	98,900	138,345	116,000
U. S. S. R.	2,585	12,000	50,000	50,000	(2)
United Kingdom	[1] 6,073	[1] 5,091	22,160	124,142	(2)
United States:					
Cadmium compounds [5]	257,049	230,152	284,310	375,573	195,000
Metallic cadmium	1,259,794	1,577,174	1,648,117	1,812,427	1,702,470
	2,450,000	3,150,000	3,600,000	[3] 4,200,000	[3] 4,200,000

[1] Exports.
[2] Data not available. Estimate included in total.
[3] Estimated production.
[4] The Mexican Government reports the total cadmium content of material produced in Mexico as follows: 1934, 384,714 kilos; 1935, 597,527 kilos; 1936, 535,017 kilos; 1937, 619,792 kilos; and 1938, 762,398 kilos. This material is exported for treatment elsewhere; therefore, to avoid duplication of figures, the data are not included in this table.
[5] Estimated cadmium content.

REVIEW BY COUNTRIES

Australia.—The Electrolytic Zinc Co. of Australia, Ltd., recovered 35 long tons of cadmium from Tasmanian zinc ores and 147 tons from other ores, chiefly from Broken Hill. In 1937, 45 tons were derived from Tasmanian ores and 162 tons from other ores. Cadmium byproducts are recovered at the Port Pirie lead smelter, South Australia. Forty-six tons of precipitates were produced in 1937 and presumably shipped to Risdon for refining. Data are not available on the cadmium content of these products and the quantity produced in 1938.

Canada.—Cadmium is obtained as a byproduct at the electrolytic zinc plants at Trail, B. C., and Flin Flon, Manitoba. Production at Trail increased from 218 short tons in 1937 to 255 in 1938, whereas that at Flin Flon declined from 154 to 94 tons owing to the fact that stocks of precipitates accumulated before the cadmium plant was opened in 1936 were exhausted in June 1938.

Germany.—The increase in output in 1938 reflects the larger production of zinc in that year. Cadmium is recovered at the Magdeburg electrolytic zinc plant and at the Oker vertical-retort smelter. The Magdeburg plant can produce 150 to 180 metric tons of cadmium annually. According to American Consul Sydney B. Redecker, Frankfort on the Main, Germany treats cadmium-bearing flue dusts from South-West Africa, imports of which have been as follows: 64 tons in 1934, 145 in 1935, 99 in 1936, and 133 in 1937. Figures for 1938 are not available.

Despite the increased output in 1938 there was a scarcity of cadmium. Imports increased considerably, but data thereon are not recorded separately. Norway, Poland, Italy, and the United Kingdom supplied most of the metal imported in 1938.

Italy.—The new 100-ton-per-year plant at Porto Marghera was put into operation in June 1938. Italy's production now exceeds domestic requirements.

Japan.—The Metal Bulletin, London (Jan. 10, 1939), reports that Japanese demand for cadmium is supplied largely by production from the Miike works of Mitsui Mining Co., the Hosokura and Naoshima works of the Mitsubishi Mining Co., and the Tsu plant of Nippon Soda Co. These three companies control the trade in cadmium through a cartel.

Norway.—Cadmium is recovered as a byproduct from the electrolytic zinc plant of Det Norske Zinkkompani A. S. of Eitrheim, the only producer of zinc and cadmium in Norway.

South-West Africa.—Cadmium-bearing flue dusts containing about 30 percent cadmium are produced as a smelter byproduct at the Tsumeb copper-lead mine. In 1938 exports amounted to 672 metric tons compared with 436 tons in 1937. Shipments in 1938 were consigned to Antwerp, Belgium.

PLATINUM AND ALLIED METALS

By H. W. Davis

SUMMARY OUTLINE

The outstanding statistical feature of the platinum industry in 1938 probably was the phenomenal increase in production in Alaska. Although the United States is by far the largest consumer of platinum metals in the world, prior to 1935 only small quantities were produced annually from domestic sources. For example, the average annual production was only about 8,300 ounces from 1925 to 1934, inclusive. Since then, however, domestic output (chiefly of placer platinum in Alaska) has advanced progressively from 11,552 ounces in 1935 to 49,380 ounces in 1938.

Salient statistics of platinum and allied metals in the United States, 1937–38, in troy ounces

	1937	1938		1937	1938
Production:			Stocks in hands of refiners, Dec. 31:		
Crude platinum from placers	10,803	[1] 42,043	Platinum	60,236	71,058
New metals:			Palladium	21,942	30,071
Platinum	[2] 36,174	[2] 30,444	Other	17,321	16,782
Palladium	5,945	3,653			
Other	3,139	2,116		99,499	117,911
	45,258	36,213	Imports for consumption:		
			Platinum	148,809	127,832
Secondary metals:			Palladium	45,427	26,858
Platinum	55,926	44,654	Other	12,701	6,499
Palladium	12,680	13,489			
Other	3,600	6,148		206,937	161,189
	72,206	64,291	Exports:		
			Unmanufactured	59,567	33,635
			Manufactures (except jewelry)	2,874	796

[1] Subject to revision.
[2] In 1937 includes 9,255 ounces of new platinum from domestic sources, comprising 4,466 ounces derived from crude placer platinum, 28 ounces recovered from ore, and 4,761 ounces obtained from domestic gold and copper ores as a byproduct of refining; 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 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 1938, for example, 36,213 ounces of new platinum metals and 64,291 ounces of secondary platinum metals were recovered by domestic refiners, 161,186 ounces of unmanufactured platinum metals were imported for consumption, and 33,635 ounces of platinum and 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, the bulk of the new platinum metals recovered by refiners in the United States in 1938, as in previous years, was derived from crude platinum from foreign sources, notably Colombia, as most of the Alaska platinum was refined abroad. Most of the refined new platinum metals now consumed in the United States come from the United Kingdom; the metals are recovered there chiefly as a byproduct in refining nickel-copper matte from the Sudbury district of Ontario and, to smaller extents, from matte from the Rustenburg district of the Union of South Africa and placer platinum from the Goodnews Bay district of Alaska.

Shifts in sources of supply.—The year 1938 probably marks the beginning of another period of transition in world production of platinum metals. During the present century and especially during the past two decades, the sources of supply of platinum metals have undergone several changes, owing chiefly to the decline in Russian output, the increased production in Colombia following the introduction of dredges, the successful recovery of platinum-group metals from the nickel-copper ore of the Sudbury (Ontario) district and from the oxidized and sulfide ores of the Transvaal, and the inauguration of mechanized equipment at the placer deposits in the Goodnews Bay district, Alaska.

Prior to 1900 the U. S. S. R. was the source of probably 90 percent of the platinum metals produced in the world, most of the remainder coming from Colombia. From 1900 to 1914 the U. S. S. R. contributed about 95 percent and Colombia the bulk of the remainder. The World War and the subsequent revolution had a depressing effect on the production of platinum metals in the U. S. S. R., and the output dropped to a low of about 20,000 ounces in 1921. Meanwhile, in Colombia the Government became stable, engineering methods were introduced, and production advanced fairly rapidly. Consequently, from 1915 to 1924 Colombia supplied about one-third of the world output, whereas the share of the U. S. S. R. fell to about one-half. Canada and the United States furnished the bulk of the remainder.

After several years devoted to experimental refining and to the development and selection of processes for the recovery of precious metals from the nickel-copper ore of the Sudbury (Ontario) district, a refinery was built in 1924 at Acton, England, to handle annually some 30,000 ounces of platinum metals. Refining at Acton was begun in 1925, and 16,980 ounces of platinum metals were produced there. As production of nickel and copper continued to mount, the annual capacity of the Acton refinery was enlarged to 300,000 ounces of platinum metals. In 1930 Canada recovered 68,000 ounces and became the second largest producer of platinum metals; in 1934, with an output of 200,000 ounces, it succeeded the U. S. S. R. as the world's largest producer. Canadian output increased to 259,000 ounces in 1937 and to 292,000 ounces in 1938.

Although osmiridium had been known to occur in the Witwatersrand district of the Transvaal since its discovery in 1892, it was not until 1921 that regular production was begun at several of the larger mines on the Far East Rand. From 510 ounces in 1921, output increased to 5,764 ounces in 1924 and has averaged 5,779 ounces annually during the decade 1929–38.

Almost simultaneously with the first recovery of osmiridium on a large scale on the Rand came the opening of the platinum deposits in the Waterberg district of the Transvaal, followed in the latter part of 1924 by the important discoveries in the Lydenburg district of the same Province. The first production (10,545 ounces) of platinum metals from these districts was recorded in 1926. The Waterberg district had a short-lived and altogether disappointing history. Important discoveries were made in the Potgietersrust field during 1925 and shortly thereafter in the Rustenburg district. In 1930 production of platinum metals in the Lydenburg, Potgietersrust, and Rustenburg districts had reached 55,342 ounces; in consequence, the Union of South Africa ranked as the third largest producing country, Colombia dropping to fourth.

Despite the fact that operations were discontinued in the Potgietersrust and Lydenburg districts after 1930, the Rustenburg district with a production of 47,163 ounces of platinum metals in 1931 still ranked slightly ahead of Colombia. In 1932 and 1933, however, production dropped to 9,246 and 2,386 ounces, respectively, owing to the drastic decline in sales, which caused suspension of operations in the Rustenburg district from April 1932 to July 1933. Consequently, Colombia regained third place in 1932 and retained it through 1935. With resumption of operations in August 1933 production in the Rustenburg district averaged about 34,000 ounces annually during the 3 years 1934–36. Meanwhile, with recognition of the necessity of treating sulfide ore, prompted by the approaching exhaustion of oxidized ore in the Rustenburg group of mines, experiments were carried out on the technical problems, apparently with much success. In 1937 the milling capacity of the Rustenburg plant was increased to 20,000 tons a month to provide crushing and sorting equipment for handling sulfidic ore, and a smelting plant to treat the concentrates produced from the sulfides was completed and put into operation in November. As a consequence, production in the Rustenburg district increased to 39,625 ounces in 1937 and reached an all-time record of 68,683 ounces in 1938.

Prior to 1935 the United States had contributed only a negligible quantity to the world output of platinum metals. For example, during the 10 years 1925–34 production averaged only about 8,300 ounces annually—1,000 ounces of placer platinum, 600 ounces from palladium-bearing copper ore, and 6,700 ounces as byproducts of gold and other metals. Although important deposits of placer platinum were discovered in the Goodnews Bay district of Alaska about 1926, only a small quantity was produced through 1933. Following consolidation of claims and installation of dragline scraper equipment in 1933, production of placer platinum in Alaska increased progressively from 3,101 ounces in 1934 to 9,823 ounces in 1937. Concurrently, byproduct production from gold and other metals advanced from 2,335 to 10,578 ounces.

The successful use of dragline-scraper equipment in Alaska led to installation and completion of a dredge with 8-foot buckets late in 1937. Consequently, production of platinum metals in the United States jumped to 49,380 ounces in 1938—42,043 ounces of placer platinum, 7,247 ounces recovered from gold and copper refining, and 90 ounces from platinum-bearing ore. Thus, the United States attained the rank of fourth largest producer of platinum metals in 1938.

Figure 1 shows graphically the trend in world production of platinum metals from 1914 to 1938, inclusive. The prominent position of Canada since 1930 and especially since 1934 is strikingly revealed, as

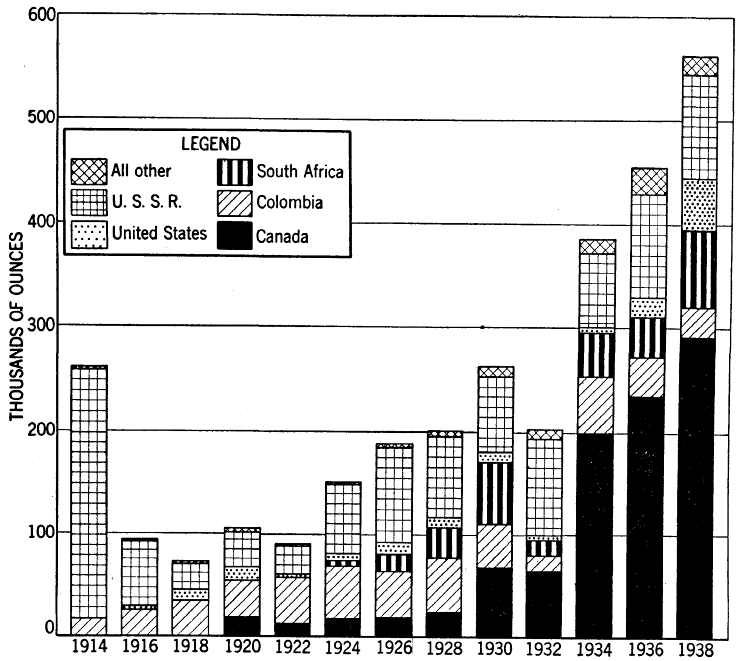

FIGURE 1.—Trend in world production of platinum metals, 1914–38.

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 production of crude-platinum metals, whereas those for 1930, 1932, and 1934 are exports of refined platinum.

CRUDE PLATINUM

Production.—Mine returns for 1938 indicate a production of 41,000 troy ounces of crude platinum in Alaska, 1,000 ounces in California, and 43 ounces in Oregon—a total of 42,043 ounces. Comparable figures for 1937 are 9,823 ounces in Alaska, 935 ounces in California, 3 ounces in Nevada, and 42 ounces in Oregon—a total of 10,803 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 platinum produced was a byproduct of dredges working the gold placers in Merced, Placer, Sacramento, Shasta, 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 1938, 7,247 ounces of platinum metals were recovered as a byproduct of refining gold and copper ores compared with 10,578 ounces in 1937.

Purchases.—Platinum refiners in the United States reported purchases of domestic crude platinum from the following sources in 1938: Alaska, 3,658 ounces; California, 1,308 ounces; and Oregon, 27 ounces—a total of 4,993 ounces (7,537 ounces in 1937). Refiners in the United States also reported purchases of 28,324 ounces (34,703 ounces in 1937) of foreign crude platinum in 1938—23 ounces from Canada, 24,604 ounces from Colombia, 1,894 ounces from Ethiopia, 18 ounces from the Philippine Islands, and 1,785 ounces from the Union of South Africa.

Prices.—Buyers reported purchases at $20.94 to $33 an ounce for domestic and $20.15 to $31.34 an ounce for foreign crude platinum in 1938.

REFINED PLATINUM METALS

New metals recovered.—Reports from refiners of crude platinum, gold bullion, and copper indicate that 36,213 ounces of platinum metals were recovered in the United States from these sources in 1938, a decrease of 20 percent from 1937. It is estimated that 10,599 ounces of the total output in 1938 were derived from domestic sources.

New platinum metals recovered by refiners in the United States in 1938, by sources, in troy ounces

	Platinum	Palladium	Iridium	Osmiridium	Others	Total
Domestic:						
Crude platinum	2,590	23	383		266	3,262
Ore	25				65	90
Gold and copper refining	3,761	3,429	57			7,247
	6,376	3,452	440		331	10,599
Foreign: Crude platinum	24,068	201	807	384	154	25,614
Total recovery: 1938	30,444	3,653	1 247	384	485	36,213
1937	36,174	5,945	1,998	640	501	45,258

New platinum metals recovered by refiners in the United States, 1934–38, in troy ounces

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1934	43,392	1,471	1,588	585	238	47,274
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

Secondary metals recovered.—In 1938, 64,291 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 11 percent from 1937.

Secondary platinum metals recovered in the United States, 1934–38, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1934	35,494	5,606	1,328	1,328	43,756
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	64,201

Prices.—Refiners reported the following prices for platinum in 1938: High \$43, low \$24, and average for the year \$33.83 an ounce compared with \$76, \$28, and \$46.84 an ounce, respectively, for 1937. They gave the following prices for palladium: High \$28, low \$17, and average for the year \$23.21 an ounce compared with \$28.50, \$18, and \$23.21 an ounce, respectively, for 1937.

Consumption.—The accompanying table shows sales of platinum metals to domestic consumers by refiners in the United States in 1938. 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 sale of imported platinum metals that are handled by domestic refiners. Sales by refiners totaled 127,306 ounces in 1938 compared with 172,130 ounces in 1937.

The uses of the platinum-group metals are many and varied. The most widely used metal of the group is platinum itself, which constituted 87,568 ounces (68.8 percent) of the total platinum metals sold by domestic refiners in 1938. The largest use of platinum is in jewelry, where rich color and intrinsic value are desirable factors. About 51 percent (44,654 ounces) of the total sales of platinum by domestic refiners in 1938 went to the jewelry trade compared with 52 percent (49,848 ounces) in 1937. Although platinum and its companion metals are generally associated in the public mind with jewelry, they have diversified industrial uses. For example, the chemical industry, the second-largest consumer of platinum, purchased 14,328 ounces from domestic refiners in 1938 (18,300 in 1937), the dental industry 12,324 ounces (11,115 in 1937), and the electrical industry 5,645 ounces (9,465 in 1937).

Palladium, which is about half as common as platinum but less costly, is adapted to many of the same uses as platinum. It comprised 35,073 ounces (27.5 percent) of the total platinum metals sold by domestic refiners in 1938. The largest consumer of palladium in 1938 was the dental industry, which purchased 18,833 ounces (54 percent of the total) from domestic refiners. The electrical and jewelry industries are the next largest consumers of palladium, and small quantities are used in the manufacture of chemical ware.

Iridium, best known as a hardening addition to platinum, ranks third among the platinum-group metals according to consumption. Of the total sales of platinum metals in 1938, 3,297 ounces (2.6 percent) were iridium.

Sales of the other platinum metals—rhodium (useful as an alloying element with platinum and palladium) and the still rarer ruthenium and osmium (used as hardening additions in special-purpose alloys)—are small and amounted to only 1.1 percent of the total for the group in 1938.

Platinum metals sold by refiners in the United States in 1938, by domestic consuming industries, in troy ounces

Industry	Platinum	Palladium	Iridium	Others	Total	Percent of total
Chemical	14,328	402	143	159	15,032	12
Electrical	5,645	10,447	616	231	16,939	13
Dental	12,324	18,833	148	34	31,339	25
Jewelry	44,654	5,356	2,358	316	52,684	41
Miscellaneous and undistributed	10,617	35	32	628	11,312	9
	87,568	35,073	3,297	1,368	127,306	100

The apparent consumption of platinum in the United States, as calculated from statistics on production, imports, and exports, is given in the following table.

Apparent consumption of platinum in the United States, 1936–38, in troy ounces

Year	Recovered by domestic refiners			Imports of ingots, bars, sheets, or plates	Exports (unmanufactured and manufactures, estimated)	Apparent consumption
	Primary	Secondary	Total			
1936	39,728	55,959	95,687	52,013	46,000	101,700
1937	36,174	55,926	92,100	62,052	50,000	104,000
1938	30,444	44,654	75,098	44,091	27,000	92,000

Stocks.—On December 31, 1938, 117,911 ounces of platinum metals were in the hands of refiners compared with 99,499 ounces at the end of 1937.

Stocks of platinum metals in the hands of refiners in the United States, Dec. 31, 1934–38, in troy ounces

Year	Platinum	Palladium	Iridium	Others	Total
1934	41,370	26,377	8,269	7,905	83,921
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

FOREIGN TRADE [1]

Imports.—Imports into the United States of platinum metals were 161,189 ounces in 1938, compared with 206,937 ounces in 1937. The principal sources of imported platinum metals in 1938 were the United Kingdom (101,987 ounces), the U. S. S. R. (31,431 ounces), and Colombia (22,251 ounces). Imports of palladium (chiefly from the United Kingdom) decreased to 26,858 ounces in 1938 from 45,427 in 1937.

Platinum metals imported for consumption in the United States, 1934–38

Year	Troy ounces	Value	Year	Troy ounces	Value
1934	174, 312	$4, 157, 518	1937	206, 937	$7, 418, 364
1935	164, 149	4, 228, 022	1938	161, 189	4, 366, 912
1936	210, 440	5, 996, 034			

Platinum metals imported for consumption in the United States, 1937–38, by metals

Metal	1937		1938	
	Troy ounces	Value	Troy ounces	Value
Platinum:				
Ores of platinum metals (platinum content)	1, 186	$43, 481	3, 263	$71, 504
Grain and nuggets	24, 405	922, 795	26, 176	688, 166
Sponge and scrap	61, 152	1, 834, 294	54, 299	1, 496, 491
Ingots, bars, sheets, or plates not less than ⅛-inch thick	62, 052	3, 141, 910	44, 091	1, 371, 246
	148, 795	5, 942, 480	127, 829	3, 627, 407
Manufactures of, not jewelry	14	676	3	150
Iridium	5, 568	531, 537	1, 717	118, 849
Osmiridium	3, 306	84, 203	2, 501	61, 391
Osmium	366	14, 317	440	16, 349
Palladium	45, 427	742, 081	26, 858	448, 152
Rhodium	2, 925	86, 863	1, 613	87, 276
Ruthenium	536	16, 207	228	7, 338
	206, 937	7, 418, 364	161, 189	4, 366, 912

Platinum metals (unmanufactured) imported for consumption in the United States in 1938, 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			237						237
Canada			737	21	2		101		861
Colombia	842	21, 409							22, 251
Ethiopia	2, 412	215							2, 627
Japan			175						175
Netherlands				12					12
Norway			930		425		69		1, 424
Panama			2						2
Philippine Islands		18							18
Switzerland				85					85
Union of South Africa			5	71					76
U. S. S. R.				31, 431					31, 431
United Kingdom	9	4, 534	52, 213	12, 471	1, 290	2, 941	26, 688	1, 841	101, 987
	3, 263	26, 176	54, 299	44, 091	1, 717	2, 941	26, 858	1, 841	161, 186

[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.

Exports.—Exports of unmanufactured platinum metals totaled 33,635 ounces in 1938, of which Germany took 8,345, France 6,906, Argentina, 6,862, and Japan 6,159 ounces.

Platinum and allied metals exported from the United States, 1934–38

Year	Unmanufactured		Manufactures of, except jewelry	
	Troy ounces	Value	Troy ounces	Value
1934 [1]	1,897	$83,337	759	$35,456
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

[1] Excludes exports by parcel post.

Platinum and allied metals exported from the United States in 1938, 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	6,862	$241,998		
Brazil	134	5,635	86	$3,326
Canada	774	40,801	28	2,103
China	878	27,198	3	149
Cuba	214	7,438	18	1,060
France	6,906	239,435		
Germany	8,345	261,752		
Japan	6,159	218,339		
Palestine	52	1,839	554	18,987
Turkey	537	15,400		
United Kingdom	2,628	90,498	8	324
Other countries	146	6,311	99	5,162
	33,635	1,156,644	796	31,111

PRODUCTION IN FOREIGN COUNTRIES

Belgian Congo.—The production of platinum and palladium in the Belgian Congo was 2,122 and 12,507 ounces, respectively, in 1937 compared with 3,183 and 12,571 ounces in 1936.

Canada.—Recoveries of platinum metals from the nickel-copper ores of the Sudbury district of Ontario were 161,310 ounces of platinum and 130,893 ounces of other platinum-group metals in 1938 compared with 139,355 ounces of platinum and 119,829 ounces of other platinum-group metals in 1937.[2] Sales of platinum metals by the International Nickel Co. of Canada, Ltd., were 193,195 ounces in 1938 compared with 188,756 ounces in 1937.

Placers in British Columbia yielded only 7 ounces of stream platinum in 1938 compared with 22 ounces in 1937.

Colombia.—Colombia exported 29,460 ounces of crude platinum in 1938 (29,315 in 1937). Of the 1938 exports, 52 percent went to the

[2] Dominion Bureau of Statistics, Preliminary Report on the Mineral Production of Canada During the Calendar Year 1938: Ottawa, 1939.

United States, 47 percent to Germany, and the remainder to France and Japan.

The South American Gold & Platinum Co. produced 20,714 ounces of crude platinum and 63,622 ounces of crude gold in 1938 compared with 18,345 ounces of crude platinum and 42,956 ounces of crude gold in 1937.

Germany.—Although the output of platinum metals in Germany is confined to small quantities of platinum and palladium recovered as byproducts in the treatment of copper ores, the country is important in the international platinum trade. Imports of platinum metals and alloys into Germany were 140,482 ounces in 1938 (121,076 ounces in 1937). The chief sources of supply in 1938 were Great Britain (69,388 ounces), the Netherlands (15,268 ounces), the United States (12,423 ounces), and Colombia (12,011 ounces). Exports of platinum metals and alloys from Germany were 32,569 ounces in 1938, of which 18,323 ounces went to Switzerland.

Platinum metals and alloys imported into and exported from Germany, 1934–38, in ounces

Year	Imports	Exports	Year	Imports	Exports
1934	73,641	72,304	1937	121,076	23,512
1935	84,981	102,288	1938	140,482	32,569
1936	[1] 525,883	32,553			

[1] Includes platinum sweeps, electrolytic muds, used-up platinum contact material, and scrap.

Union of South Africa.—According to the Department of Mines and Industries, sales of platinum metals in South Africa in 1938 were 38,862 ounces valued at £223,776 (£5.76 an ounce) compared with 30,125 ounces valued at £237,663 (£7.89 an ounce) in 1937. The average composition of the product shipped in 1937 was platinum 72.53 percent, palladium 19.78 percent, iridium 0.20 percent, osmium and osmiridium 0.12 percent, ruthenium 1.72 percent, and gold 5.65 percent.

The enlarged plant at Rustenburg of Potgietersrust Platinum, Ltd., for handling sulfidic ores was brought into full operation in July 1938.[3] Flotation concentrates are now smelted on the property in a blast furnace and subsequently reduced in bulk by a converter. The matte is shipped to England for further treatment.

Sales of osmiridium in 1938 were 5,233 ounces valued at £34,110 (£6.52 an ounce) compared with 5,667 ounces valued at £37,254 (£6.57 an ounce) in 1937. The average composition of the product shipped in 1937 was osmium 29.92 percent, iridium 26.35 percent, ruthenium 13.48 percent, platinum 11.27 percent, gold 2.51 percent, rhodium 0.48 percent, and undetermined 15.99 percent.

U. S. S. R.—No authentic statistics are available on the production of platinum in the U. S. S. R. in recent years. However, it is generally estimated that an annual output of 100,000 ounces of crude platinum has been maintained.

[3] South African Mining and Engineering Journal, vol. 69, pt. 2, December 10, 1938, p. 434.

WORLD PRODUCTION

World production of platinum and allied metals, 1934–38, in troy ounces

[Compiled by M. T. Latus]

Country and product	1934	1935	1936	1937	1938
Australia:					
New South Wales: Placer platinum	180	98	47	46	(1)
Tasmania: Placer osmiridium	488	235	281	586	191
Belgian Congo: From refineries:					
Palladium	3,569	5,144	12,571	12,507	(1)
Platinum	1,254	965	3,183	2,122	(1)
Canada:					
Placer platinum	53	39	20	22	7
From refineries: [2]					
Platinum	116,177	105,335	131,551	139,355	161,310
Other platinum metals	83,932	84,772	103,671	119,829	130,893
Colombia: Placer platinum (exports)	54,216	38,020	38,333	29,315	29,460
Ethiopia: Placer platinum	5,644	6,320	8,038	(1)	(1)
Japan: Placer platinum	118	51	34	(1)	(1)
New Zealand: Placer platinum	-------	14	29	55	(1)
Panama: Placer platinum	-------	16	19	267	(1)
Papua: [3]					
Placer platinum	96	46	21	20	41
Placer osmiridium	4	9	17	8	4
Sierra Leone: Placer platinum	474	750	484	308	180
Union of South Africa:					
Platinum (content of platinum metals)[4]	26,369	19,954	19,751	17,776	18,253
Concentrates (content of platinum metals)[4]	11,372	11,317	13,163	21,849	50,428
Osmiridium [5]	5,088	5,047	5,431	5,790	5,354
U. S. S. R.: Placer platinum [6]	100,000	100,000	100,000	100,000	100,000
United States:					
Placer platinum	3,720	9,069	9,785	10,803	[7] 42,043
Ore (content of platinum metals)	-------	-------	110	124	90
From refineries: [8]					
Platinum	1,062	1,361	4,443	4,761	3,761
Other platinum metals	1,273	1,122	4,541	5,817	3,486

[1] Data not yet available.
[2] Recovered from nickel-copper mattes.
[3] Year ended June 30 of year stated.
[4] Produced from platinum ores.
[5] Produced from treatment of gold ores on the Rand.
[6] Approximate production.
[7] Subject to revision.
[8] New platinum metals recovered in gold and copper refining of domestic materials.

MINOR METALS

By Paul M. Tyler

SUMMARY OUTLINE

During the last decade or two it has become increasingly apparent that the atoms of all the 92 elements can be broken down into smaller atoms, modifying their characteristics and changing their identities. Conversely, it has been found that lighter elements can be made into heavier ones, and new elements have been created that are heavier than any found in nature.

In January 1939, probably first in Copenhagen but almost simultaneously in three American laboratories, it was proved that uranium actually could be cracked in two, and, furthermore, that almost inconceivable amounts of energy (in the neighborhood of 200,000,000 volts) were thus released. A few days later thorium, another heavy element (atomic weight, 232), was split by the million-volt atom-smashing machine at the Carnegie Institution of Washington, and similar results were reported from independent experiments at Johns Hopkins University and (earlier) at the Institute for Theoretical Physics in Copenhagen.

Part of the novelty of these discoveries lies in the hint they give as to methods of tapping the tremendous store of atomic energy, the force that holds all matter together. Previously such concentrations of energy had been known to be produced only in the interior of the sun and the stars. Almost as important is the magnitude of the change in the nature of the atoms. Atom smashing hitherto had succeeded only in abrading or chipping off tiny fragments, producing changes somewhat akin to the spontaneous degeneration of radioactive elements into more or less related substances, but in this latest transmutation the properties of each of the new elements are entirely different from those of the parent element.

The practical importance of these discoveries is yet to be learned. They give promise of the fabrication of rare elements from common ones and the capture for use as industrial power of the limitless, yet still inaccessible, energy sealed in the atoms of terrestrial matter. Enabled now to reshape atomic structures so violently, scientists are better equipped to solve other mysteries of the constitution of matter and to explore further the mechanics of creation of the universe.

Masurium (element 43), one of the products of this major cleavage of uranium, is an element so rare in nature that the claim of the Noddacks that they discovered it some years ago has been questioned. Conclusive verification is believed also to be lacking of the existence of illinium (61), of eka-iodine or "alabamine" (85), and of eka-cesium or "virginium" (87). Obviously none of these elements is likely to be found on the earth's surface except in amounts too minute to be important commercially. Knowledge of rhenium likewise would be confined to spectroscopic data and scientific conjecture had it not chanced to be concentrated in the slime from an industrial process. Only this accident makes it possible to produce rhenium at a potential rate of 1 or 2 tons a year when its richest known ore carries only a fraction of 1 percent of the element. A German journal (Naturwissenschaften) is credited [1] with the suggestion that stable isotopes of elements 43 and 61 may not actually exist; in such case further attempts to isolate them even in a laboratory are foredoomed to failure.

It is impracticable for the Bureau of Mines to report faithfully each year the advances along all frontiers of scientific investigation of metals. For certain of the rarer metals it can scarcely keep pace with quasi-industrial developments. An attempt was made in Minerals Yearbook, 1937, to review the commercial status of every one of the metals, but subsequent reviews for the minor metals mention only those for which new information has come to the author of the chapter. More specifically it may be said that the omission of reference to certain elements in the following review does not imply that such elements are deemed less important commercially or less significant scientifically than those that are discussed in some detail.

BERYLLIUM

Notwithstanding the great interest displayed by several chemical-manufacturing companies, inventors, and investors and the various rumors of new enterprises engaged in producing beryllium on a more or less large scale, the world output of beryl probably still fails to exceed 750 tons a year. In the United States the commercial supply of the metal and its commercial compounds continues to come entirely from two companies—the Beryllium Corporation of Pennsylvania (Andrew Gahagan, president), Temple (near Reading), Pa.; and the Brush Beryllium Corporation (C. B. Sawyer, president), 3714 Chester Avenue, Cleveland, Ohio.

The Beryllium Corporation of Pennsylvania, which has a cooperative arrangement with Siemens & Halske, the leading German beryllium producer, for the exchange of information and patents, recently has completed a fabricating plant at Reading, Pa., the first to be designed especially for rolling and drawing beryllium alloys. In 1935 this company transferred its plant activities from Michigan to Pennsylvania and engaged in the production of nonsparking tools and other beryllium-copper castings but continued to sell a major portion of its output in the form of master alloys to the American Brass Co. and the Riverside Metal Co. for remelting and fabrication. Under the new set-up the Beryllium Corporation of Pennsylvania, however, will be in a position to supply all kinds of beryllium and copper

[1] Chemistry and Industry (London), Elements Still Missing: Vol. 57, No. 32, August 6, 1938, p. 740.

products, including sheet, strips, wire, and tubing as well as castings, finished alloy, ingots, and master alloys. Inasmuch as it also will produce sheet bars and billets from the molten alloys, the new policy may result in other fabricators undertaking the manufacture of some of these products, thereby broadening the market. The equipment of the new fabricating plant is much heavier than that hitherto employed for forming the hardest copper alloys, and all operations from the purchase of the ore to the marketing of the products to the ultimate consumer will be under the technical control of the one company. The capacity of the plant exceeds anticipated needs at present and can be increased readily as required.

Price has always been a deterrent to more rapid expansion in the use of beryllium. The price of the beryllium content of master alloys was reduced a year ago from $30 to $23 a pound of Be content, but the base price of finished beryllium-copper products (about 2.25 percent Be) had to be increased from 89 cents to $1.12 a pound owing to the difficulties of fabrication. According to information furnished to the Bureau of Mines it is expected that this price can soon be reduced. To meet the demand for a material intermediate in physical properties between standard beryllium copper and phosphor bronze an entirely new group of alloys is being offered. One series contains 0.4 to 0.5 percent Be, 2 or 3 percent cobalt, and the rest copper; another is similar, except that chromium replaces cobalt; and still another comprises beryllium-nickel alloys that heretofore have not been manufactured commercially in the United States.

Possibly the most significant development in the beryllium industry during 1938 was the interest in the wider use of the element in munitions, more specifically in vital parts of airplane engines. Of interest also is the employment of beryllium or, better, an 80-percent ferroberyllium, for cementing steel. Beryllium dissolves readily in gamma iron, and by a suitable technique a maximum penetration of 20 to 25 millimeters can be obtained—with the case-hardened surface showing a hardness of over 1,000 Brinell.[2] Beryllium oxide films may be used to prevent tarnish on silver, although preliminary reports [3] indicate that aluminum may be as satisfactory, and of course it is much cheaper.

Among alloys in practical use are nickel with 2.5 percent Be, which hardens to 600 Brinell after quenching from 1,100° C. and drawing at 400° to 500° C., and 18-carat gold, which beryllium hardens to 300 Brinell. Steel with 36 percent nickel and 1 percent beryllium is rustless and machinable, but like Invar it does not expand or contract when heated. Beryllium forms a eutectic with iron at 9.2 percent Be and 1,150° C., and this alloy can be refined in grain by heat treatment. Tin-beryllium alloys containing 0.2 percent Be are 20 percent less ductile than pure tin but are slightly harder and have improved bending strength. When the proportion of beryllium is increased primary crystals of beryllium form in a ground mass containing only a few tenths of 1 percent Be. Beryllium additions to aluminum-magnesium alloys prevent loss of Mg by oxidation during melting, prevent surface defects on castings, and inhibit discoloration during heat treatment. They tend, likewise, to promote coarser structure,

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[2] Kontorovich, I. E., Diffusion of Beryllium in Iron Alloys: Metallurgy, vol. 12, No. 6, 1937, pp. 21–30; Chem. Abs. vol. 32, No. 14, July 1938, p. 5356.

[3] Price, L. E., and Thomas, G. J., The Tarnishing of Silver and Silver Alloys and Its Prevention: Jour. Inst. Metals, vol. 63, 1938. Reviewed in Min. and Met., vol. 19, November 1938, p. 495.

increasing the time of heat treatment and decreasing mechanical properties, but this disadvantage is neutralized by adding a little titanium. Only 0.02 percent Be is required in these alloys, and it is obtained from a master alloy containing about 90 percent Be and 7 to 12 percent Mg made by adding the double fluoride of these metals to the surface of an aluminum bath at about 1,350° F.[4]

The search for uses of other alloys and even of the metal itself continues unabated, but practical sales effort in the United States hitherto has been focused mainly on expanding the demand for beryllium-hardened copper in electrical devices and small machines. This alloy, which is soft and ductile before heat treatment and easily fabricated, can be made hard and high in elastic properties by simple one-stage treatment. Its exceptional resistance to fatigue and good electrical conductivity make it a valuable material for flat and coil springs. To illustrate the remarkable life of beryllium copper, one manufacturer reports that vibrator springs, heavily stressed 230 times per second and subjected to severe temperature changes, exhibited no measurable alteration in physical or electrical performance after 2 billion vibrations.

About 1 ton of beryllium worth 3,000 francs per kilogram (about $40 a pound) is now being produced annually in France. A leading electrical company makes it by electrolysis in a fluoride bath from beryl obtained near Limoges and Autun, supplemented by supplies from Madagascar. Italy, Japan, and possibly other countries are credited with small or occasional outputs, but the United States and Germany produce the bulk of the world beryllium supply in the form of alloys.

Beryl occurrences have been reported in various parts of the United States, but few mines outside of the Black Hills, S. Dak., have produced as much as a carload, and most of the domestic production has been obtained as a byproduct of feldspar, lithium, or rare-metal ore mining. No statistics of domestic output are available. A substantial part of domestic consumption in recent years has been supplied by imports, which in 1938 amounted to 146 short tons valued at $5,990, all from British India and Argentina excepting a 10-ton lot from the Union of South Africa. In 1937 imports were 182 tons valued at $8,031, and in 1936 they were 162 tons valued at $6,681.

Deposits of beryl in U. S. S. R. have recently been reviewed.[5] The most important deposit, which also yields emeralds, is some 70 kilometers from Sverdlovak, in the Urals; the beryl is associated with talc, mica, chlorite, and actinolite schists. In a recent report, which confirms previous reports, Hungarian bauxites are found [6] to contain only 0.005 to 0.01 percent BeO, far too little to encourage hopes of industrial recovery of the beryllium.

More beryl is being offered than can be consumed at present demand levels, and the price is still quotable at $30 a ton f. o. b. mines for 10- to 12-percent ore and up to $55 a ton delivered at consuming plants for higher grades. These figures correspond to an ore cost of approximately $1.25 a pound of recovered beryllium metal, which could be increased substantially if necessary to stimulate mining and still per-

[4] Gauthier, G., Improvement of Cast Aluminum-Magnesium Alloys by Additions of Beryllium and Titanium: Foundry Trade Jour. (London), vol. 59, November 17, 1938, p. 373.
[5] Sherbakov, D., Beryllium Deposits in U. S. S. R.: Redkie Metal. No. 1, 1936, pp. 35–42. Neues Jahrb. Mineral. Geol., Ref. II, 1937, pp. 667–669; Chem. Abs., vol. 32, No. 16, Aug. 20, 1938, pp. 6192–6193.
[6] Szelenyi, Tibor, Beryllium in Bauxites: Math. naturw. Anz. ungar. Akad. Wiss., vol. 65, 1937, pp. 231–246; Chem. Abs., vol. 32, No. 5, March 10, 1938, p. 1616.

mit the metal to be made at well under $5 a pound. Many people have labored under the delusion that beryllium cannot be sold at less than $23 a pound, even in its master alloys, because conversion costs are excessively high; this is not true. Suitable methods of reducing the metal from its ores have already been worked out, and they are not inherently expensive. On the other hand, very large sums have been spent upon research, educational campaigns, patents, and other expenses incident to the development of a new metal, and the burden of these expenses has had to be borne by a relatively small volume of actual sales. It is confidently asserted that $10 a pound is an early possibility, provided the scale of operations can be substantially increased. It is somewhat less certain what can be done about lowering prices to the ultimate consumer because less is known as to the cost of manipulating the alloys; however, a base price of 75 cents for the standard 2.25-percent copper alloy is mentioned tentatively as being in sight, and eventual reduction to not more than double the cost of phosphor bronze seems likely.

CALCIUM

Calcium is recognized as a coming metal and already has begun to find industrial applications, especially as a scavenger and alloying element. The United States is the largest user, but France and Germany are the leading producers. Imports of calcium in 1938, almost all from France, amounted to 41,299 pounds valued at $16,144, as against 23,767 pounds and $10,087 in 1937. Imports of calcium alloys, however, declined, those of calcium silicide (a steel-making alloy imported chiefly from Norway but also from France) being reduced to 701 short tons valued at $77,003, from 1,876 tons and $205,173 in 1937.

The present status of the industry has been reviewed recently and comprehensively in a French paper.[7] Owing to its relatively high cost (65 cents to $1.50 a pound), calcium has not found general use in steel making, but its use for deoxidizing stainless and special-alloy steels increased in 1938. Either the metal or the hydride is employed as a reducing agent in the production of sundry rare metals, such as titanium, vanadium, and uranium.

COLUMBIUM AND TANTALUM

World production of tantalum and columbium ores rose from about 6 tons in 1930 to 200 tons in 1934 and probably to about 750 tons annually in 1937 and 1938. This expansion is due mostly to the increased output of columbite for use chiefly in making ferrocolumbium. Columbium-bearing stainless steels successfully withstand high temperature, are more weldable than ordinary stainless steel, and are more resistant to corrosion. In 4- to 6-percent chromium steel, columbium reduces air hardening and stabilizes the physical properties, especially impact strength. The metal itself is very similar in general properties to tantalum, but when gas-free it is more ductile and can be more easily worked into wire and sheets. According to Kreuchen [8] the melting point of columbium is 2,500° C., more

[7] Bastien, P., Le Calcium: Fabrication, propriétés et applications métallurgiques: Chim. et ind., vol. 39, No. 4, April 1938, pp. 121-132T.
[8] Kreuchen, Dr. K. H., Niobium Metal: Chem. Fabrik, Nos. 41 and 42, 1937; Canadian Chem. and Process Ind., vol. 22, May 1938, p. 183.

than 350° under that of tantalum. It resists gases as well as tantalum up to a temperature of 300° C. but burns in air at about 400° C. At high temperatures columbium hydride, a glass-hard material, is formed. Columbium shows good resistance to corrosion, except by hydrofluoric acid, concentrated sulfuric acid, concentrated hydrochloric acid, and strong alkalies; in virtually every instance chemical attack seems to be due to the action of hydrogen and the formation of the brittle hydride.

The great affinity of tantalum and columbium for all common gases has led to an extensive use of both metals in the vacuum-tube industry. The remarkable resistance to corrosion of tantalum explains its use in chemical-plant equipment, and the great hardness of carbides of tantalum and columbium has led to their increasing use in carbide compositions. One of the newer applications for tantalum is in a complete absorption system for producing hydrochloric acid. Tantaloy, an extremely hard tantalum alloy, is nonmachinable but is supplied in bars, rods, and other simple shapes for welding upon base metals. It is used principally in the chemical industries for spray nozzles and wear-resisting surfaces but is recommended also for general abrasion- and corrosion-resisting service, as well as for use in cutting tools, the purpose for which it was originally designed. Balke has covered the uses of these metals in some detail.[9] In a later paper [10] he describes methods for producing ductile bars of these metals by powder metallurgy. Tantalum carbide tool compositions have been discussed by McKenna.[11]

The world's tantalite has come principally from Western Australia; the Wodgina property in the Pilbarra field has produced 20 or 30 tons yearly from alluvial material below a pegmatite outcrop. The concentrates carry less than 10 percent Cb_2O_5 and average approximately 65 percent Ta_2O_5. Columbite recently has been produced, principally in connection with tin placer mining, in Nigeria, which reported shipments of 707 tons in 1937 and reserves approximating 10,000 tons.[12] The leading producer in 1937 was Jantar-Nigeria, which shipped 410 tons to the United States; a half-dozen other companies made shipments to England. During the last year or two the Belgian Congo has been described as a possible producer of both tantalum and columbium ores. Mathieu[13] expects this colony to become an important source of these minerals. The average tantalum content of the Belgian Congo deposits seems to be higher than that of the Nigerian product but lower than that of the product of the Pilbarra field in Western Australia. Tantalite has been found in Australia also at Grant's Creek 17 miles west of Forsyth, associated with albite in pegmatite; the importance of the occurrences in this area has not yet been determined.[14] In 1938 a production of 7 tons of tantalite valued at £1,742 was reported in Uganda.

In the United States, the main supply of tantalum ore has been imported from Australia and raw material for making ferrocolumbium

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[9] Balke, C. W., Columbium and Tantalum: Ind. and Eng. Chem., Ind. Ed., vol. 27, No. 10, 1935, pp. 1166–1169.

[10] Balke, C. W., Ductile Tantalum and Columbium: Am. Inst. Min. and Met. Eng. Tech. Pub. 927, Metals Technol., vol. 5, No. 4, June 1938, 4 pp.

[11] McKenna, P. M., Tantalum Carbide Tool Compositions: Am. Inst. Min. and Met. Eng. Tech. Pub. 897, Metals Technol., vol. 5, No. 2, February 1938, 12 pp.

[12] Mining Journal (London), Nigerian Mining: Vol. 203, November 26, 1938, p. 1090.

[13] Mathieu, F. F., Les gisements des minerais de tantale et de niobium: Ext. from pubs. de l'Association des Ingenieurs de la Faculté Polytechnique de Mons 1er fascicule 1938, No. 64, pp. 49–139; Bureau of Mines Mineral Trade Notes, vol. 6, No. 6, June 20, 1938, pp. 24–25.

[14] Mining Magazine (London), vol. 58, No. 6, June 1938, p. 346.

from Nigeria. In 1938 the imports of tantalite rose to 41,706 pounds valued at $80,092, compared with 20,897 pounds valued at $40,742 in 1937; the imports of columbite declined to 645,141 pounds valued at $228,078 from 922,654 pounds and $306,086 in 1937.

However, small lots of tantalum-bearing ores (chiefly columbo-tantalite) have come from New Mexico, Wyoming, Colorado, North Carolina, and Virginia and have also been reported in California, Connecticut, Maine, and South Carolina.[15] At present, the only important domestic sources of ore used for making tantalum metal are the deposits in the Black Hills of South Dakota, although there is a small output from Amelia, Va.

Shipments of tantalum-bearing ores in the United States, 1934–38

Year	Pounds	Value	Year	Pounds	Value
1934	2,425	$968	1937	16,307	$13,317
1935	7,681	4,521	1938	36,189	35,127
1936	----------	----------			

The first real interest in commercial production of tantalum ores other than as a byproduct was in 1927, when some good showings were opened up while a road was being graded through the east side of a pegmatite dike in connection with construction of a 150-ton concentrator for the Black Hills Tin Co. After the production of several tons of concentrates containing 38.7 to 57.0 percent Ta_2O_5 in 1928 and 1929, operations were discontinued until 1936 when amblygonite was identified on the dumps, which accordingly were worked over for lithium ores. The Fansteel Mining Co., a wholly owned subsidiary of the Fansteel Metallurgical Corporation, obtained a lease on the property in February 1937, sunk a 60-foot shaft, and drifted southward under the ore, which is mined by open pit, dropped through raises, and eventually hoisted from the shaft. Approximately half the tonnage mined is sorted out as waste, the remainder going to a small mill, where it is crushed to minus 8-mesh and tabled. The geology of the occurrence has been discussed by Hess and Bryan.[16]

INDIUM

No metal costing almost $30 an ounce can hope to enter the industrial field unchallenged, but the systematic search for uses for indium seems likely to bear fruit in the relatively near future. In a comprehensive review of available information on indium published in 1938,[17] Grasselli Chemical Co. technologists report that it is doubtful whether any of the numerous suggested uses have yet been adopted on a commercial scale. The most promising outlet, they believe, is in precious-metal alloys for jewelry and dental work, in which indium increases resistance to corrosion. Silver-indium alloys containing 1 to 25 percent indium have been developed for plating silverware to prevent tarnishing, and a dental amalgam base (patented) containing

[15] Johnson, A. I., Tantalum from the Black Hills: Eng. and Min. Jour., vol. 139, No. 11, November 1938, pp. 39–42.
[16] Hess, F. L., and Bryan, B., Jr., The Pegmatites at Tinton, S. Dak.: Bureau of Mines Rept. of Investigations 3404, June 1938, 19 pp.
[17] Lawrence, R. E., and Westbrook, L. R., Indium; Occurrence, Recovery, and Uses: Ind. and Eng. Chem., vol. 30, No. 6, June 1938, pp. 611–614.

95 percent mercury and 5 percent indium is claimed to improve the mechanical properties of the filling. Indium further lowers the melting point of low-melting alloys; addition of 18 percent indium to Wood's metal yields a metal that is fluid at 46.5° C. Other potential uses include bearing metals (especially those utilizing the new technique of plating on and diffusion into cadmium alloys, as described by Smart [18]), mirrors, medicine, and glass making. Indium oxide and sulfur compounds impart light-yellow to dark-yellow amber colors to glass, and only 0.05 percent indium oxide is said to give a beautiful yellow glass. Binary indium-tin alloys have been investigated recently; they show higher resistance to both fatigue and corrosion, yet are soft and ductile. Other alloys investigated previously include those with copper, gallium, lead, lithium, silver, sodium, tellurium, and zinc, respectively. The search for commercial outlets is still being pushed vigorously because potential supplies are relatively large.

With the introduction of various wet methods of extracting zinc, indium and certain other rare metals have become readily available if needed. Indium and sundry associated metals are extracted from the complex waste mud from these processes with hot dilute sulfuric acid and reprecipitated by treating the solution with zinc. The resulting sponge, which contains not only indium but also cadmium and a little lead, nickel, tin, and copper, is filtered off and leached first with not quite enough hot dilute acid to dissolve the cadmium. Further leaching of the remaining sponge dissolves other metals, and after lead sulfate and other insoluble matter have been filtered out this second solution is treated with an excess of ammonia thereby precipitating indium hydroxide, which can be separated, washed, and eventually ignited to trioxide. Metallic indium of 97 to 98.5 percent purity is made directly from this impure trioxide by an electrolytic method and can be purified further if required.

MESOTHORIUM

Mesothorium is used medicinally in the treatment of cancer and skin diseases and in luminous paints as a radium substitute. Actually almost all material so designated contains more radium than mesothorium, but as the latter is approximately 30 times as radioactive the product is sold as mesothorium. There are no official statistics of domestic production or exports. Imports are classified as "radioactive substitutes" and shown in value only. Ordinarily they are not very important, but in 1938 they jumped to $5,746 compared with $711 in 1937. The bulk of the small domestic consumption is supplied by domestic sources. As most users require a National Bureau of Standards certificate before they purchase material, the following record of such tests affords a fair measure of the output and demand in the United States.

Mesothorium is produced in this country from the residues of monazite sand after thorium and cerium have been extracted for use in gas mantles. The extraction process is very much like that for radium. The residues are digested in hot concentrated sulfuric acid and treated with barium salts to form a precipitate of mesothorium-barium sulfate, which is filtered, redissolved by treatment with sodium carbonates, and purified by a long series of fractional crystallizations.

[18] Smart, C. F., Indium-Treated Bearing Metals: Am. Inst. Min. and Met. Eng. Tech. Pub. 900, Metals Technol., vol. 5, No. 3, April 1938, 13 pp.

Mesothorium tested by National Bureau of Standards, 1928–38

Year	Number of specimens	Milligrams	Year	Number of specimens	Milligrams
1928	12	521	1934	29	1,026
1929	6	242	1935	24	612
1930	12	449	1936	13	331
1931	6	286	1937	21	416
1932	1	41	1938	18	373
1933	8	136			

The only known foreign producer is Deutsche Gasglublicht Auergesellschaft, Frankfort on the Main, Germany, a leading gas-mantle manufacturer.

RADIUM AND URANIUM

Early in 1939 it was reported that a marketing agreement had been concluded between Union Minière du Haut Katanga (operating in the Belgian Congo) and Eldorado Gold Mines, Ltd. (Canada), for marketing radium, whereby the former will supply 60 percent and the latter 40 percent of world requirements. Some years ago an agreement was in effect between the Belgian company and the Czechslovak Government, but in recent reports no mention is made of outside production. The Joachimsthal (Jachymov) deposits in the Ore Mountains lie in territory ceded to Germany; they are of interest not only because they normally supply 1 to 3 grams of radium a year but also because they supplied the pitchblende that Mme. Curie employed in all her early work. Small quantities of radium ores are produced in the United States, the U. S. S. R., and Portugal.

Canada entered the ranks of radium producers with an output of 3.025 mg. in 1933 and became an important factor when its output rose to 15.54135 grams in 1936. By the middle of 1938 its operating rate had been stepped up to 1 gram of radium salts weekly, with a projected capacity of 85 grams yearly. The estimated output for the year was 70 grams compared to the 1937 total of 23.77014 grams. According to reports by the Dominion Bureau of Statistics (Ottawa), 25,486 tons of ore were hoisted during 1937 at the Eldorado mine, which yielded a total of 674.5 tons of concentrates and cobbed ore, comprising 475.3 tons of pitchblende-silver, 193.3 tons of silver-copper (flotation), and 5.9 tons of cobalt (cobbed) concentrates. Receipts of pitchblende concentrates at the company Port Hope (Ontario) refinery were 339 tons; but only 294 tons, yielding 302 tons of roasted ore, were put through the roasting and milling plant in 1937, and of the latter only 290 tons entered into the chemical treatment. Recovery of both radium and uranium was about 90 percent and of silver about 96 percent. It is stated that about 5.2 tons of uranium salts are recovered per gram of radium. Silver is marketed as silver sulfide to refineries in the United States, and the total value of all products was reported at $850,000 in 1937. This figure includes the value of radioactive lead, which was recovered in the form of lead sulfate to meet an industrial demand for radium D; the ore contains about 5 percent such lead. The company recently has offered radioactive lead oxide made from this lead, which is required for scientific and research purposes.

Eldorado Gold Mines stock sold at $1.38 to $3.25 per share in 1938, compared with a maximum of $8.10 in 1933 when the property was still in the development stage. Ore reserves valued at $5,956,482 on December 1, 1937, were marked up to $7,000,000 in June 1938. The company report states that as of October 1, 1938, unfilled orders for radium exceeded $700,000, and sales during the first 9 months totaled $1,007,539, about 100 percent ahead of 1937. Mill costs at Port Hope have been cut 20 percent, and mining and concentrating costs at Great Bear Lake also have been reduced, whereas prices of uranium and uranium products have increased.

A few other occurrences of pitchblende have been reported in Canada. The Consolidated Mining & Smelting Co. did considerable development on claims near Common Lake, adjoining the Eldorado property to the northeast, but suspended its work in June 1936. Parcels of ore have been shipped from discoveries made several years ago at Beaverlodge and Hardisty Lakes about 100 miles to the south, and pitchblende was discovered in 1935 near Goldfields, on Lake Athabasca, where it occurs in narrow veinlets that also carry gold. Canada Radium Mines conducted underground exploration for radioactive minerals in pegmatite at Cheddar near Wilberforce in northern Hastings County, Ontario, but suspended this work in 1937. The Bear Exploration & Radium, Ltd., following much surface and underground development, made a test shipment of silver ore as early as 1934 from its property at Cameron Bay, Great Bear Lake. In 1938 this company was reorganized and refinanced by the Eldorado Mines, Ltd., and began producing concentrates.

Radium is sold in grades according to the percentage purity of the salt. The usual purity is 98 percent. For domestic transactions radium is compared at the National Bureau of Standards with the National Radium Standard, a duplicate of the international standard prepared by Mme. Curie and deposited in Paris. Other duplicates are found in leading capitals throughout the world. The measurement involves comparison of the electrical energy carried by the X-rays, and certificates are issued. During 1938 the National Bureau of Standards, under the supervision of Dr. L. F. Curtiss, tested 1,280 radium preparations with a radium content of 10.5 grams compared with 1,703 preparations containing 9 grams in 1937.

Imports of radium salts into the United States rose in 1938 to an all-time record of 38.75 grams valued at $787,025, compared with 15.29 grams valued at $377,659 in 1937. The previous record was only 21.97 grams in 1934, but owing to the somewhat higher prices then prevailing the valuation in that year was $1,082,462. Imports of uranium oxides and salts never exceeded 20,000 pounds a year until 1926 but have been increasing almost steadily to a peak of 341,040 pounds valued at $374,110 in 1936. After dropping to 203,473 pounds with a value of $258,417 in 1937, they advanced to a new high record of 376,708 pounds valued at $520,540 in 1938.

Radium salts are marketed either in the form of implants in gold or platinum needles containing 1 to 12½ mg. or in sealed tubes of glass, silver, or platinum containing 10 to 100 mg. Radon, or emanation, ordinarily is sold in gold implants or "seeds" 5 to 7 mm. long and 0.5 mm. in diameter. An outer case of lead is customarily employed to decrease danger of handling. Radium for radiograph testing of metals may be placed in small drum-shaped silver containers holding 100 mg.

A recent proposal is to use tungsten shields which, owing to their greater density, may be more effective than those of other metals, including lead.

In some hospitals the radium is stored in solution, and only radon is collected and used.

"Radium Protection" (National Bureau of Standards Handbook H 23) is a manual of recommended precautions to be observed by those whose work involves handling of this dangerous element.

Radium is often handled in such minute quantities that occasional loss is inevitable—100 mg., the usual dose for treating cancer, would barely cover the head of a pin. Because it is worth roughly 18,000 times its weight in pure gold and especially because it menaces the lives of those who may unwittingly come into contact with its destructive rays, ingenious devices have been developed to recover it. About 20 of these devices—most of them home-made affairs using gold-leaf electroscopes—are in use in the United States, and of 107 reported losses 59 complete recoveries and 11 partial recoveries of radium have been made, according to an interesting article by Taft.[19]

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. The principal use of radium is therapeutic, its chief application being in the treatment of cancer, although radium therapy is employed also for the treatment of sundry dermatological conditions and other diseases. The principal industrial use has been in luminous paints for watch dials, instrument scales, switches, press buttons, signboards, and signals. A more recent development is the use of radium by physical metallurgists for inspecting metal castings for flaws. Radium is much easier to handle than X-rays and is said to give even better results.

Radium and uranium content of carnotite ores produced in the United States, 1934–38

Year	Carnotite ores (short tons)	Radium content (milligrams)	Uranium content (pounds)	Year	Carnotite ores (short tons)	Radium content (milligrams)	Uranium content (pounds)
1934	254	1,007	6,661	1937	1,708	3,141	20,764
1935	1,145	3,329	22,009	1938	4,290	7,821	51,705
1936	1,439	2,716	17,961				

Notwithstanding its high price, uranium, mother of radium, is used extensively in ceramics.[20] A stain of sodium uranate, alumina, and silica is used in strongly fired glazes to produce ivory to yellow shades, and in low-fired lead glazes a tomato-red color is obtained by the addition of 15 to 20 percent sodium uranate. Uranium oxide is used in glazed pottery to produce luster or iridescence, coloring the ware greenish yellow, and in glass to yield a wine-yellow color in transmitted light and a greenish-yellow fluorescence in reflected light.

After failing to justify its high price as a ferro-alloying element, uranium is now being added to copper. R. R. Mallory & Co., Inc., Indianapolis, Ind., offers a hard ternary alloy containing copper and uranium which, it is claimed, affords improved performance and

[19] Taft, R. B., Radium Hounds: Sci. American, vol. 160, January 1939, pp. 8, 47.
[20] Harbert, C. J., Less Familiar Elements in Ceramic Pigments: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 7, July 1938, pp. 770–772.

longer life to current-carrying or heat-carrying members of electrical machinery. Besides its high electric and thermal conductivity, this new alloy is unusually resistant to corrosion by a wide variety of gases and liquids, according to Business Week (December 24, 1938, p. 27).

At the close of 1938 sodium uranate, Na_2UO_4, was quoted at $1.75 to $1.80 per pound for either the yellow or orange variety; uranium oxide, 96 percent U_2O_6, in 100-pound lots at $2.65 to $2.75 a pound for the black and $1.75 to $1.80 for the yellow or orange product.

RARE EARTHS

The rare earths continue to command the attention of numerous research workers, although commercial developments are impeded by their high price. Paradoxically, the rare-earth metals are not extremely rare in nature. But they are difficult to separate, and many of their potential uses can be satisfied by cheaper elements. The oxides of cerium are used in ceramics and special glasses. A good résumé of the use of rare earths in the glass industry was published [21] recently, and another paper [22] calls attention to the availability of lanthanum as a byproduct of recovering thoria and ceria from monazite and its potential applications in the ceramic and glass industries, for weighting silk, as a catalyst, and as a constituent of alloys. Ceric oxide is one of the best opacifiers [23] for enamels, yet it is seldom used even in Europe.

Neodymium and praseodymium [24] occur in all cerium minerals in a ratio of at least two parts neodymium to one part praseodymium. Recently neodymium (which stains glass violet) has been applied successfully as a physical decolorizer for glass. Didymium, a mixture of neodymium and praseodymium, gives a neutral-gray glass.

As an illustration of the wide distribution of the rare earths, the Bureau of Chemistry and Soils in cooperation with the National Bureau of Standards has recently identified substantial traces of rare-earth metals in the ashes of many plants. The rare-earth concentrate from hickory leaves grown in a pegmatite vein amounted to 0.2 percent of the dry weight of the leaf.

The Glass Industry (January 1939 issue) quoted cerium hydrate (100-pound drums and 600-pound barrels) at 60 cents a pound, neodymium oxalate (50-pound drums) at $3.50 a pound, and "rare-earth hydrate" at 30 cents (325-pound barrels) to 35 cents (100-pound drums) a pound.

SELENIUM AND TELLURIUM

More and more selenium is being recovered from copper refining; and, as the use of selenium in glass no longer seems to be increasing, the search for new uses has been resumed. The demand for tellurium is still much less than that for selenium and only a fraction of the quantity that could be recovered if byproduct sources were fully utilized. Tellurium is used to increase the toughness and resistance

[21] Ctyroky, V., Importance of Rare Earths for the Glass Industry: Sklarske Rozhledy, vol. 15, 1938, pp. 23-33; Ceram. Abs., vol. 17, No. 8, August 1938, p. 274.

[22] Arndt, E., and Pütter, K. E., Importance of Lanthanum as a Raw Material: Angew. Chem., vol. 51, 1938, pp. 463-464; Jour. Soc. Chem. Ind., London, vol. 57, No. 9, September 1938; British Chem. Abs., B, p. 1052.

[23] Harbert, C. J., Less Familiar Elements in Ceramic Pigments: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 7, July 1938, pp. 770-772.

[24] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 11.

to abrasion of rubber hose and cable coverings. Increasing amounts of tellurium lead are being marketed, but this outlet is only a small one, as it takes only a few hundredths of 1 percent of tellurium to harden, toughen, and increase the corrosion resistance of ordinary lead. According to a report of the International Tin Research and Development Council (Pub. 81) tellurium also improves remarkably the work-hardening properties and creep strength of tin; in quantities up to 0.1 percent it improves somewhat the tensile strength and hardness. Industrial hazards from selenium and its toxicity are the subject of a recent Government report.[25] Further research indicates that the bad effects of selenium in soils have been greatly exaggerated.[26] In fact some plants seem to be stimulated by selenium, and a few may actually need it to thrive.[27]

Prices of selenium (black, powdered, 99.5 percent) remained virtually unchanged in 1938 at $1.75 to $1.85 a pound in New York but rose slightly to 7s. 3d. in London. Barium selenide, $BaSeO_3$, is quoted in domestic glass-trade journals at $1.40 to $1.60 a pound, while the quotation for the "commercial" grade (25 percent Se) remains at 85 cents. Sodium selenite, Na_2SeO_3, which is also used in glassmaking, is quoted at $1.50 to $1.65 a pound in 1938. New York quotations of $2 a pound for tellurium have remained unchanged for several years, and London trade journals continue to quote the metal at 7s.

Production, sales, and imports of selenium and production and sales of tellurium in the United States, 1934–38

Year	Selenium				Tellurium	
	Production (pounds)	Sales [1] (pounds)	Imports		Production (pounds)	Sales [1] (pounds)
			Pounds	Value		
1934	254,394	319,838	17,719	$24,591	27,214	21,027
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

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

TITANIUM

Because of their great whitening and obliterating power, titanium pigments continue to be employed widely in paint, rubber, linoleum, leather, plastics, soap, printing inks, paper, textiles, and ceramics. In addition to the well-known white pigments an important rich-yellow pigment has recently been developed that contains chromium and antimony as well as titanium dioxide. Ilmenite, used chiefly for making titanium pigments and to a smaller extent for making ferroalloys, is produced in the United States in Virginia, Arkansas, and California, but the main supply is imported from British India, by far the world's largest producer. Rutile is produced in this country, both for domestic consumption and for export and is also imported

[25] Dudley, H. C., Selenium as a Potential Industrial Hazard: U. S. Public Health Rept. 53, 1938, pp. 281–292.
[26] Lakin, H. W., Williams, K. T., and Byers, H. G., "Nontoxic" Seleniferous Soils: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 5, May 1938, pp. 599–600.
[27] Trelease, Sam, and Helen M., Selenium as a Stimulating and Possibly Essential Element for Certain Plants: Science, vol. 87, No. 2247, 1938, pp. 70–71.

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from Brazil and Australia. Deposits are being opened up in various other countries. The principal uses of rutile are in welding-rod coatings and ceramics; the former recently has become the most important outlet, consuming as much as 1,200 to 2,500 tons a year.[28]

The Bureau of Mines is not at liberty to publish figures of domestic production of ilmenite and rutile. Imports of rutile declined to 130 short tons valued at $26,533 in 1938 compared with 665 tons and a value of $67,643 in 1937. Those of ilmenite continued their phenomenal expansion, reaching 201,545 long tons valued at $1,018,430 compared with the previous record of 153,993 tons valued at $770,757 in 1937.

The rapid growth of the titanium industry and the increasing variety of uses for the element in its sundry products have been reviewed in previous volumes of Minerals Yearbook and are not repeated in this chapter. During 1938 ilmenite was discovered in Natal, payable quantities being reported in sand dredged from Durban Bay. In southern Egypt the Hamata Mining Co., already engaged in mining manganese, installed equipment for producing ilmenite. Rutile, which has been mined sporadically in French Cameroons in Africa, may be mined more systematically following the gradual acquisition of mining rights in the numerous areas. Rutile has been produced extensively in Australia from beach sands at Byron Bay and elsewhere in New South Wales where it occurs with zircon. Deposits of this mineral in South Australia were visited in 1937 by the Government Inspector of Mines, who cautioned against premature expansion of the existing pilot plant which can treat a maximum of 2 tons of crushed ore, equivalent to about 180 pounds of 80 percent concentrate, daily.[29] In South Africa the property in Omaruru that produced over 16 tons of rutile from a high-grade deposit (4 to 20 percent TiO_2) was idle in 1938, having been optioned to an overseas firm according to a Government report. The Dominion Bureau of Statistics (Ottawa) reveals a sharp increase in production of titanium ore in Canada to 4,229 short tons valued at $26,432 in 1937, with a drop to 207 tons worth $1, 449 in 1938. The entire output was shipped from St. Urbain, Quebec, to ferro-alloy manufacturers. In France titanium, as well as vanadium and zircon, may be recoverable from "red mud" from bauxite refining.

A new titanium mineral, $FeTiO_3.Fe_3O_4.TiO_2$, is reported [30] from Nellore, India.

Engineering and Mining Journal quotations for titanium ore in 1938 were: Ilmenite, 45 to 55 percent TiO_2, f. o. b. Atlantic seaboard, $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 was reduced 1 cent at the end of the year to 14 and 14½ cents a pound (carloads). Phthalate-treated pigment was quoted at 22 to 22½ cents per pound with extras for smaller quantities.

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[28] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 12.
[29] Imperial Institute (London), South Australian Rutile: Bull., vol. 36, January–March 1938, p. 78.
[30] Jayaraman, N., and Krishnaswami, K. R., Chemical and Mineralogical Study of a New Titanium Mineral from Nellore: Proc. Indian Sci. Cong., 25th Cong., 1938, pt. 3, p. 117; Ceram. Abs., vol. 17, No. 7, July 1938, p. 261.

ZIRCONIUM

Australia, India, and Brazil still supply the bulk of the world's zircon, and Brazil is the only source of baddeleyite. Zircon sand is present in concentrates and black sands from California placer-gold mining. It was recovered in commercial quantities for the first time in 1937 in the sluice boxes of the Kaufield dredge, 2 miles east of Lincoln, Placer County, Calif. Exact figures are not available but this appears to be the first domestic production since 1927 when operations at Pablo Beach, Fla., ceased.

The rise to importance of zirconium during the last quarter of a century and the many uses of the metal and its compounds and alloys have been discussed in previous volumes of Minerals Yearbook and are covered more fully in recent papers published by the Foote Mineral Co.[31] An even more comprehensive review appeared in a foreign trade journal.[32]

According to Saklatwalla [33] copper containing 14 to 16 percent zirconium metal yields an alloy comparable to beryllium copper. A new alloy, Silvaz, containing 6 to 6.5 percent zirconium has been developed as a steel refiner. It also contains about 6 percent each aluminum and vanadium and about 40 percent silicon (balance iron). This alloy is claimed to produce better results in refining steel than separate additions of the respective alloys, particularly as to yield and Izod impact ductility. One new use for zircon sand is in the manufacture of molds for cast steel, and another is as an insulator in electric heating devices.

Zirconium metal is used in radio tubes (wire) and rayon spinneret cups (sheet). Zirconium-silicon and zirconium-ferrosilicon alloys are used in steel making, whereas the powdered metal goes into flashlight mixtures and ammunition primers. Even in the aggregate the requirements for such purposes are small, and the bulk of tonnage is in the form of compounds for use in ceramics and welding-rod coatings. The main consumption is in enamel and glaze frits which employ not only zirconium oxide but also zircon and sodium zirconium silicate.

Engineering and Mining Journal quotations during 1938 were nominal: Zircon ore, 55 percent ZrO_2, f. o. b. Atlantic seaboard, carload lots, $55; 5-ton lots, $60 per short ton; crude granular zircon, $70 f. o. b. Suspension Bridge, New York, milled, $90.

[31] Meyer, H. C., Economics of Some of the Less Familiar Elements: Ind. and Eng. Chem., Ind. Ed., vol. 30, No. 4, April 1938, pp. 431-436.
Fast, J. D., Zirconium: Foote-Prints, vol. 10, Philadelphia, December 1937, pp. 1-24.
Preston, E., Zirconia in Glass: Foote-Prints, vol. 11, Philadelphia, December 1938, pp. 1-11.

[32] Esme, A., Zirconium Compounds and their Application in the Refractory and Ceramic Industries: Argile, No. 178, 1938, pp. 11-15; No. 179, pp. 21-23; No. 181, pp. 18-23. Ceram. Abs., vol. 17, No. 10, October 1938, p. 341.

[33] Saklatwalla, B. D., Rare Metals and Minerals: Min. and Met., vol. 20, No. 385, January 1939, p. 10.

PART III. NONMETALS

BITUMINOUS COAL [1]

By M. E. McMillan, R. L. Anderson, L. N. Plein, F. G. Tryon, and J. W. McBride

SUMMARY OUTLINE

The year 1938 proved to be an eventful one for the coal industry. The sharp drop in the demand for industrial coal resulting from the general recession in business was accentuated by the extraordinarily mild weather that reduced consumption for heating purposes. In addition, competitive fuels continued to make inroads into the diminishing coal market.

A measurable degree of relief was in prospect at the end of the year through the work of the National Bituminous Coal Commission. On February 25 this agency was forced to withdraw the marketing rules and regulations and schedules of minimum prices that it had established late in 1937. During the remainder of the year the Commission proceeded with the task of building a minimum price structure that would comply in detail with requirements of the law. Although

[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 in contributing this chapter to Minerals Yearbook to maintain the continuity of the bituminous-coal series is gratefully acknowledged.

Data for 1938 are preliminary; detailed statistics with final revisions will be released later. Data for 1937 are final.

the goal seemed to be in sight at the end of the year no one would venture to predict just when the new prices would be put into effect.

Production.—The output of soft coal in 1938 was 344,630,000 tons, a 23-percent drop below 1937. During the first 6 months of 1938 production averaged more than 30 percent below the comparable period of 1937. Although the coal industry made substantial gains along with general business during the latter half of the year, the total output for the year was only 11 percent above the record low of 1932 and 36 percent below the 534,989,000 tons of 1929. (See figs. 1, 2, and 4.)

Imports and exports.—Exports of bituminous coal fell from 13,145,000 tons in 1937 to 10,490,000 in 1938, a net drop of 20 percent. At the same time imports, which are relatively insignificant, declined 7 percent from 258,000 tons in 1937 to 241,000 in 1938. As in the past, virtually all these imports and more than 90 percent of the exports resulted from trade with Canada. (See fig. 9.)

Changes in stocks.—Over 6 million tons of the coal consumed in 1938 represented net withdrawals from consumer stocks. The

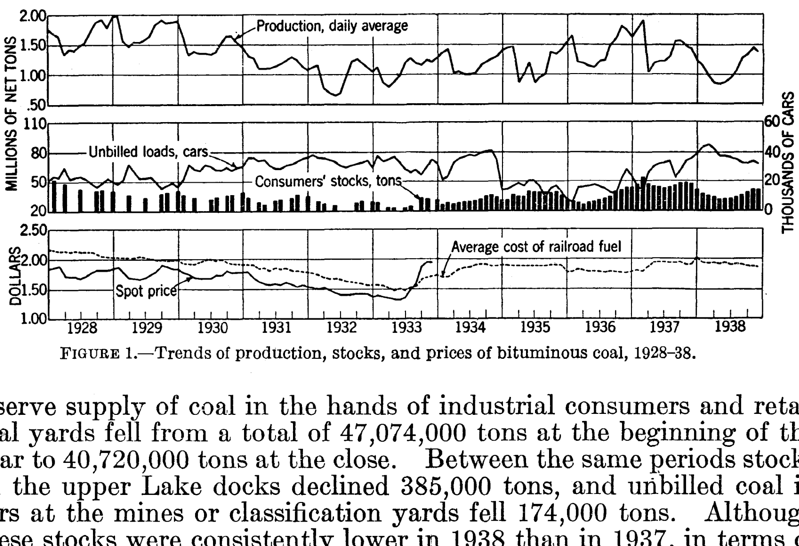

FIGURE 1.—Trends of production, stocks, and prices of bituminous coal, 1928–38.

reserve supply of coal in the hands of industrial consumers and retail coal yards fell from a total of 47,074,000 tons at the beginning of the year to 40,720,000 tons at the close. Between the same periods stocks on the upper Lake docks declined 385,000 tons, and unbilled coal in cars at the mines or classification yards fell 174,000 tons. Although these stocks were consistently lower in 1938 than in 1937, in terms of day's supply they constituted a more adequate reserve, since consumption requirements fell even more sharply than stocks. (See fig. 1 and table 33.)

Consumption.—After allowances have been made for foreign trade and changes in consumers' stocks the total consumption of bituminous coal in 1938 amounted to 340,735,000 tons, a decline of 87,762,000 from 1937. Each of the more important classes of consumers shared the reduction, which ranged from 72 percent for beehive coke ovens to 10 percent for electric power utilities. The effect of the decline in industrial consumption was augmented by the weather, since 1938 was one of the warmest years on record. (See fig. 3 and table 4.)

Distribution.—Shipments of bituminous coal during 1938 dropped sharply below the 1937 level in each of the primary channels of

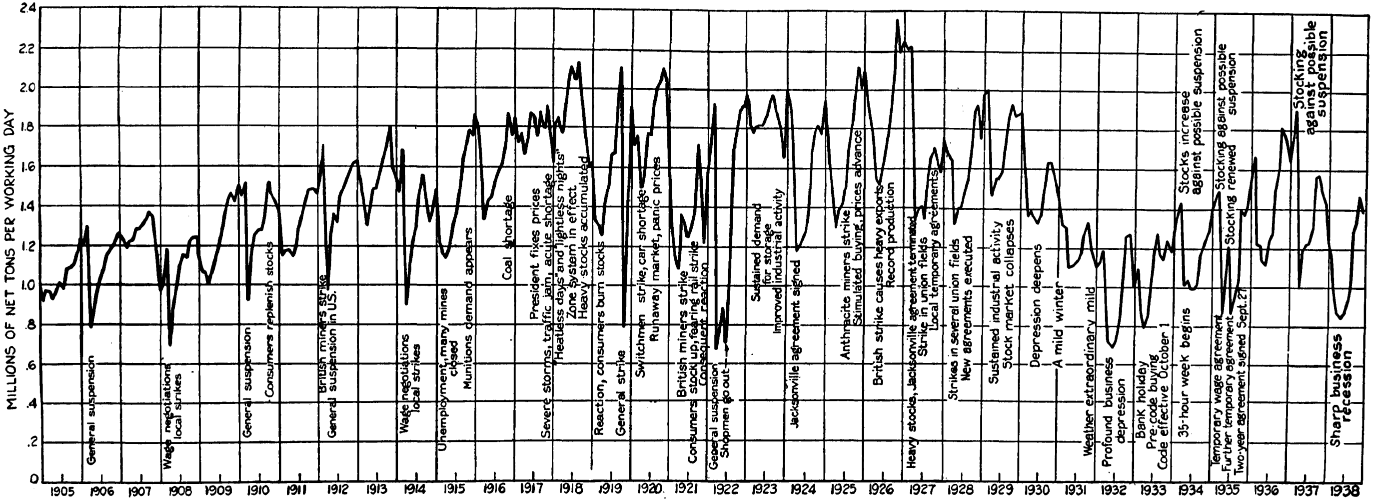

FIGURE 2.—Average production of bituminous coal per working day in each month, 1905–38.

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 $2.27 in 1938. The 10-cent-a-

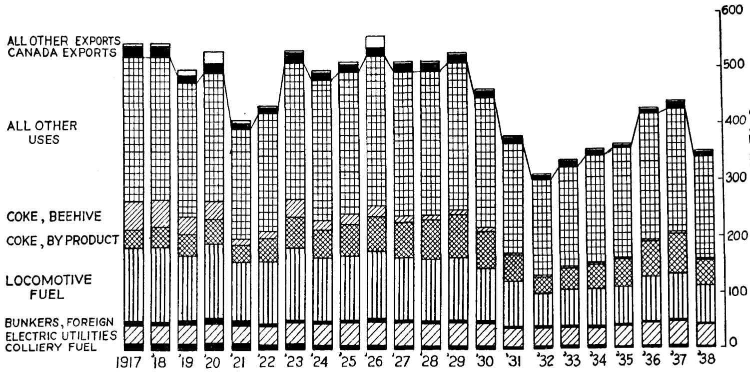

FIGURE 3.—Tonnage of bituminous coal absorbed by the principal branches of consumption, 1917–38.

ton advance over the 1937 average was a result of the new schedule of rates authorized by the Interstate Commerce Commission in Ex Parte 115. The new rates became effective on November 15, 1937, and provided for increases of approximately 9 cents per net ton east

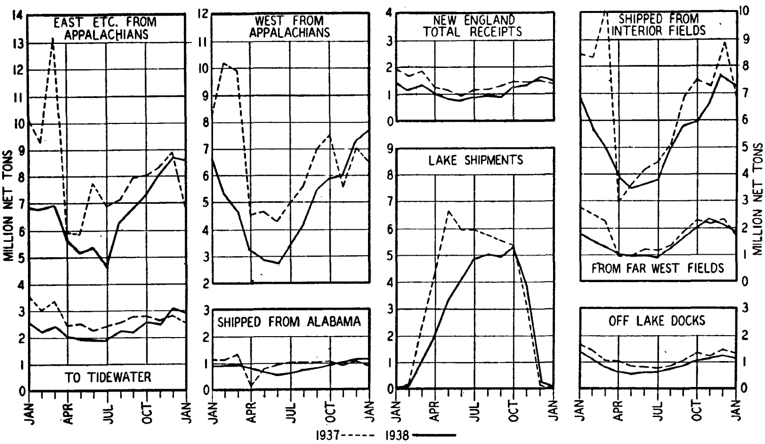

FIGURE 4.—Monthly movement of bituminous coal in the major channels of distribution, 1937–38.

of the Mississippi and 13 cents in the West. The increases ranged from 3 to 10 cents per net ton in eastern territory and from 3 to 15 cents in western, the amount depending on the basic rates.

Trend of prices.—During the first 2 months of the year prices of bituminous coal were supported by the schedules of minimum prices issued by the National Bituminous Coal Commission. After these prices were withdrawn on February 25 the market quotations slumped sharply. Prices of screenings and slack, which depend very largely on industrial demand, showed the greatest weakness.

Spot market quotations indicate that producers averaged less per ton for their coal in 1938 than in 1937. On the other hand, the Bureau of Labor Statistics series of wholesale prices, f. o. b. destination, show a slight increase for 1938 considering the year as a whole. The divergent movement of these series is explained by the advance of 10 cents a ton between the 2 years in the average cost of transporting bituminous coal by rail. This increase in freight rates more than offsets the reduction in the f. o. b. mine price of coal and raised the delivered price above the 1937 level.

Mechanization.—On the basis of data available early in 1939 Coal Age [2] estimated that "25 percent of the deep-mined output was handled by some type of loading equipment." This represents a continuation of the sharp advance in mechanical loading from 16 percent in 1936 to 20 percent in 1937.

Sales of mechanical loading equipment for use in bituminous-coal mines declined in 1938, but at a rate considerably less than the drop in production. Although the output of bituminous coal fell 23 percent the reduction in sales of loading equipment was 17 percent for mobile loaders and only 10 percent for conveyors. Reports from 29 manufacturers show sales of 241 mobile loaders for the current year as against 292 in 1937 and 344 in the peak year of 1936. Conveyor sales totaled 749 in 1938 compared with 835 in 1937 and 682 in 1936.

Details regarding mechanization and equipment in 1938 are given in a supplement to Weekly Coal Report 1127 of the National Bituminous Coal Commission, entitled "Sales of Mechanical Loading Equipment for Use in Coal Mines in 1938," by L. N. Plein, J. J. Gallagher, M. van Siclen, and F. G. Tryon. Summary articles covering the same subject were published in the February 1939 issues of Coal Age and the Mining Congress Journal. (See also fig. 7 and tables 24 and 25.)

Stripping operations.—The volume of bituminous coal produced by stripping established a new record in 1937 when 31,750,853 tons were reported—a 13-percent increase over the output in 1936, when stripping operations produced a total of 28,125,857 tons. Although the proportion of strip coal continued to rise in 1938 there was considerable reduction in the total volume produced by this type of operation owing to the general drop in industrial demand.

Mechanical cleaning.—Over 61 million tons of bituminous coal were mechanically cleaned in 1936, and preliminary estimates indicate that the amount rose to about 65 million in 1937. Construction of new cleaning plants in 1937 and 1938 added materially to the capacity of the industry to produce mechanically cleaned coal.

Trend of employment.—Estimates of the number of men employed at bituminous-coal mines in 1938 indicate a substantial drop from the 1937 figure of 491,864. Indexes compiled by the Bureau of Labor Statistics on the basis of a sample that includes more than half the workers in the industry, show a 12.7-percent drop in employment for

[2] Coal Age, February 1939, p. 28.

1938. Reports from the mining departments of six States with more than 70 percent of the bituminous-coal employees in the United States indicate an average decline of 10.6 percent for the same period. These data suggest an estimate of 435,000 employees for 1938.

In comparison with 1929, when the average number of men at bituminous-coal mines totaled 502,993, the 1938 figure represents a decrease of 68,000. The number of unemployed coal-mine workers probably exceeded this figure, however, since a considerable number attached to the industry were without jobs, even in 1929. Furthermore, if it had not been for share-the-work agreements the number of unemployed miners in 1938 probably would have been still greater. A partial solution for the unemployment problem, which became exceedingly acute during the depression period, was provided by the industry's reduction of hours for a normal workweek from 48 to 40 and later to 35.

Statistics of employment for bituminous-coal workers cannot be interpreted properly without considering the intermittent operations that characterize most coal mines. In 1937, for instance, the bituminous mines were operated an average of 193 days out of the 261 possible under the 5-day week of the union wage agreement. Consequently, a substantial part 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 continued to increase between 1936 and 1937. The coal industry reached its peak capacity in 1923 when, on 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. Increases since 1934 have raised the potential output on a 308-day basis to 710,000,000 tons in 1937.

One of the outstanding developments under the Bituminous Coal Code of the National Industrial Recovery Act was the adoption of a 5-day week for the industry. Under the 5-day week full-time operations are limited to approximately 261 days. The potential capacity of operating mines on a 261-day basis was 601,000,000 tons in 1937 compared with the total actual production of 445,531,449 tons.

Trend of fuel efficiency.—Technologic improvements in utilization of fuel since the World War have been responsible for an appreciable reduction in the demand for coal for industrial use. Although the effect tends to be cumulative it should be noted that the changes have been taking place at a much slower rate in recent years. Steam railroads reduced their coal consumption per 1,000 gross ton-miles of freight service from 117 pounds in 1937 to 115 in 1938. Between the same years electric public utility power plants managed to lower the number of pounds of coal per kilowatt-hour from 1.43 to 1.41, and steel companies cut 1.8 percent from the amount of coking coal required to produce a gross ton of pig iron.

It is evident also that savings in fuel are being effected by both domestic consumers and small industrial establishments. Increasing economy in the utilization of fuel, arising from improved heating equipment, has been supplemented by developments in insulation and building construction. Automatic stokers, weather stripping, and insulating materials have combined to limit the aggregate demand of domestic and small industrial consumers, who comprise a large segment of the national market.

Competition of oil and gas.—Although the consumption of bituminous coal by electric power plants, railroads, and steamships combined dropped 16 percent below the 1937 level the competitive use of fuel oil by the same groups of consumers decreased only 9 percent. At the same time total sales of natural gas also fell 9 percent.

Relative changes in sales of mechanical stokers and oil burners afford a slightly more encouraging picture for the coal industry. Stoker sales declined only 4 percent between 1937 and 1938, while net orders for oil burners dropped 28 percent. In absolute numbers, however, oil-burner sales exceeded mechanical stoker sales by about 50 percent.

Prospects for 1939.—The low point of the 1938 recession in the coal market was reached in June. In July the barometers of general business, which had been falling since the autumn of 1937, began to rise again. Although coal prices remained depressed, production continued on the upgrade throughout the remainder of the year. By the end of 1938 the curve of weekly production had overtaken that in the corresponding period of 1937.

The improvement noted has continued into 1939. Consumption has exceeded that in the early months of 1938. Production records up to April 1, when mining operations were suspended in the Appalachian fields, indicate that output during the first quarter of the year was running 23 percent above that for the corresponding period of 1938.

Statistical tables—1938.—Tables 1 to 5 give a statistical record of the bituminous-coal industry in 1938, as indicated by available preliminary data. They also show comparative statistics for the indicated earlier years, including final figures for 1937. (See fig. 5.)

TABLE 1.—*Salient statistics of the bituminous-coal industry, 1937–38*

[All tonnage figures represent net tons]

	1937	1938 (preliminary)	Change in 1938
Production	445,531,449	344,630,000	−22.6%
Exports to Canada and Mexico [1]	12,052,111	9,560,717	−20.7%
Exports overseas and all other [1]	1,092,567	929,552	−14.9%
Imports [1]	257,996	241,305	−6.5%
Consumption in the United States (calculated) [2]	428,496,767	340,735,036	−20.5%
Stocks at end of year:			
Industrial consumers and retail yards	47,074,000	40,720,000	−13.5%
Stocks on upper Lake docks	8,270,839	7,885,516	−4.7%
Unbilled loads, at mines or in classification yards [3]	1,780,800	1,607,200	−9.7%
Price indicators (average per net ton):			
Average cost of railroad fuel purchased, f. o. b. mines [4]	$1.89	$1.92	+3¢
Average cost of coking coal at merchant byproduct ovens [5]	$4.40	(6)	
Average cost of bunker coal to vessels in foreign trade [7]	$4.83	$4.85	+2¢
Average value of exports to all countries (at port) [8]	$3.71	$3.63	−8¢
Average retail price—38 cities [9]	$8.58	$8.61	+3¢
Average railroad freight charge per net ton [10]	$2.17	$2.27	+10¢
Underground loading machinery sold to bituminous mines: [11]			
Mobile loading machines (number)	292	241	−17.5%
Scrapers (number)	13	6	−53.8%
Conveyors, including those with duckbills (units)	835	749	−10.3%
Pit-car loaders (units)	32	139	+334.4%
Mechanically loaded, all devices (net tons)	[12] 83,500,000	(13)	
Average number of men employed at mines operating [14]	491,864	435,000	−11.6%
Fuel-efficiency indicators:			
Pounds coal per kw.-hr. at electric power plants [15]	1.43	1.41	−1.4%
Pounds per 1,000 gross ton-miles—railroads [16]	117	115	−1.7%

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 Data not available.
7 Computed from records of the Bureau of Foreign and Domestic Commerce.
8 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.
9 Bureau of Labor Statistics.
10 Average receipts per net ton of revenue bituminous coal originated, as reported by the Interstate Commerce Commission.
11 Plein, L. N., Gallagher, J. J., van Siclen, M., and Tryon, F. G., Sales of Mechanical Loading Equipment for Use in Coal Mines in 1938: Min. Cong. Jour., February 1939, pp. 40–43; see also Coal Age, February 1939, pp. 56–58.
12 Preliminary.
13 Not yet available. Coal Age, February 1939, p. 28, estimated that 25 percent of the deep-mined production was mechanically loaded in 1938.
14 The figure for 1937 is based on reports of mine operators producing over 1,000 tons. The figure for 1938 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 6 State mine departments which represent approximately 70 percent of all the bituminous-coal-mine workers in the United States.
15 Federal Power Commission.
16 Interstate Commerce Commission, includes coal equivalent of fuel oil consumed.

TABLE 2.—*Salient trends in bituminous mine operation, 1913–37*

	1913	1923	1929	1932	1934	1935	1936	1937
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	319,741,376	370,762,901	399,237,575
Loaded at mines for shipment by water...do	10,690,834	16,884,799	23,066,289	9,365,782	15,127,968	18,327,282	24,867,683	
Made into coke at mines...do	49,458,320	27,859,316	9,128,607	1,028,458	1,647,805	1,467,902	2,728,577	4,884,054
Used at mines for colliery fuel...do	11,670,903	8,765,011	4,662,974	2,780,889	3,175,057	3,102,691	3,227,447	3,052,095
Commercial sales by truck or wagon...do	13,871,828	22,081,040	23,262,558	20,392,706	[1] 18,739,320	21,960,252	27,929,298	37,762,612
Other local sales, used by employees, etc...do					7,374,143	7,773,619	9,571,997	
Total production...do	478,435,297	564,564,662	534,988,593	309,709,872	359,368,022	372,373,122	439,087,903	[2] 445,531,449
Number of active mines of commercial size:								
Class 1 (200,000 tons or more)...number	694	748	827	465	551	561	660	661
Class 2 (100,000 to 200,000 tons)...do	837	935	660	477	485	479	452	469
Class 3 (50,000 to 100,000 tons)...do	959	1,176	668	469	479	503	460	448
Class 4 (10,000 to 50,000 tons)...do	1,558	2,742	1,361	1,111	1,072	1,056	1,085	1,117
Class 5 (1,000 to 10,000 tons)...do	1,728	3,730	2,541	2,905	3,671	3,716	4,218	3,853
Total number over 1,000 tons...do	5,776	9,331	6,057	5,427	[3] 6,258	[3] 6,315	[3] 6,875	[3] 6,548
Percent of output from mines in classes 1 and 2...percent	75.4	70.4	83.1	77.5	80.5	80.7	83.8	84.1
Average number of men employed at mines active:								
Underground...men	494,238	600,305	433,999	345,905	384,947	389,942	399,367	(4)
Surface, including strip pits...do	77,644	104,488	68,994	60,475	73,064	72,461	77,837	(4)
Total...do	571,882	704,793	502,993	406,380	458,011	462,403	477,204	491,864
Average number of days mines operated...days	232	179	219	146	178	179	199	193
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	640,000,000	680,000,000	710,000,000
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	543,000,000	576,000,000	601,000,000
Output per man per day [6]...do	3.61	4.47	4.85	5.22	4.40	4.50	4.62	4.69
Output per man per year...do	837	801	1,064	762	785	805	920	906
Underground output cut by machine...percent	50.7	68.3	78.4	84.1	84.1	84.2	84.8	(4)
Underground output mechanically loaded...do	....	0.3	7.4	12.6	12.2	13.5	16.3	20.2
Quantity mined by stripping...net tons	[7] 1,280,946	11,940,134	20,268,099	19,641,128	20,789,641	23,647,292	28,125,857	31,750,853
Quantity cleaned by wet or pneumatic processes [8]...do	22,069,691	20,140,385	32,271,950	27,357,599	35,853,714	39,511,176	53,332,040	(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 1938, by States, with final figures for earlier years*

State	Production in thousands of net tons								Percent change, 1937–38	Percent of total bituminous							
	1913	1923	1929	1932	1935	1936	1937	1938 pre.		1913	1923	1929	1932	1935	1936	1937	1938 pre.
Alaska	2	120	101	103	119	137	132	137	+3.7	(1)	0.02	0.02	0.03	0.03	0.03	0.03	0.04
Alabama	17,678	20,458	17,944	7,857	8,505	12,229	12,440	10,950	−12.0	3.69	3.62	3.35	2.54	2.29	2.78	2.79	3.18
Arkansas	2,234	1,297	1,695	1,033	1,133	1,623	1,511	1,192	−21.1	.47	.23	.32	.33	.30	.37	.34	.35
Oklahoma	4,166	2,885	3,774	1,255	1,229	1,540	1,600	1,269	−20.7	.87	.51	.71	.41	.33	.35	.36	.37
Colorado	9,232	10,346	9,921	5,599	5,911	6,812	7,187	5,676	−21.0	1.93	1.83	1.85	1.81	1.59	1.55	1.61	1.65
Georgia	256	76	45	27	23	24	(2)	26		.05	.01	.01	.01	.01	.01	(2)	.01
North Carolina	-------	36	52	2			------		-------		.01	.01				----	
Illinois	61,619	79,310	60,658	33,475	44,525	50,927	51,602	40,650	−21.2	12.88	14.05	11.34	10.81	11.96	11.60	11.58	11.79
Indiana	17,166	26,229	18,344	13,324	15,754	17,822	17,765	14,050	−20.9	3.59	4.65	3.43	4.30	4.23	4.06	3.99	4.08
Iowa	7,526	5,711	4,241	3,862	3,650	3,961	3,637	3,250	−10.6	1.57	1.01	.79	1.25	.98	.90	.82	.94
Kansas	7,202	4,443	2,976	1,953	2,686	2,944	2,893	2,560	−11.5	1.51	.79	.56	.63	.72	.67	.65	.74
Missouri	4,318	3,403	4,030	4,070	3,646	3,985	4,091	3,412	−16.6	.90	.60	.75	1.31	.98	.91	.92	.99
Kentucky:																	
Eastern	11,099	33,887	46,025	25,760	32,627	39,152	38,523	31,096	−19.3	2.32	6.00	8.60	8.32	8.76	8.92	8.65	9.02
Western	8,518	10,890	14,437	9,540	8,134	8,370	8,563	7,400	−13.6	1.78	1.93	2.70	3.08	2.18	1.91	1.92	2.15
Maryland	4,780	2,286	2,649	1,429	1,678	1,704	1,549	1,306	−15.7	1.00	.40	.50	.46	.45	.39	.35	.38
Michigan	1,232	1,172	805	446	628	626	562	478	−14.9	.26	.21	.15	.14	.17	.14	.13	.14
Montana [3]	3,241	3,148	3,408	2,125	2,759	2,988	2,965	2,804	−5.4	.68	.56	.64	.69	.74	.68	.67	.81
New Mexico	3,709	2,915	2,623	1,263	1,389	1,597	1,715	1,252	−27.0	.78	.52	.49	.41	.37	.36	.38	.36
North Dakota [3]	495	1,386	1,862	1,740	1,956	2,215	2,251	2,047	−9.1	.10	.25	.35	.56	.52	.50	.50	.59
South Dakota [3]	11	11	13	49	13	41	47	48	+2.1	(1)	(1)	(1)	.02	(1)	.01	.01	.01
Ohio	36,200	40,546	23,689	13,909	21,153	24,110	25,178	17,920	−28.8	7.57	7.18	4.43	4.49	5.68	5.49	5.65	5.20
Pennsylvania (bituminous)	173,781	171,880	143,516	74,776	91,405	109,887	111,002	77,040	−30.6	36.32	30.45	26.83	24.14	24.55	25.03	24.91	22.35
Tennessee	6,860	6,040	5,406	3,538	4,138	5,108	5,213	4,373	−16.1	1.43	1.07	1.01	1.14	1.11	1.16	1.17	1.27
Texas [3]	2,429	1,187	1,101	637	758	843	910	892	−2.0	.51	.21	.20	.21	.20	.19	.20	.26
Utah	3,255	4,720	5,161	2,852	2,947	3,247	3,810	2,908	−23.7	.68	.84	.97	.92	.79	.74	.85	.84
Virginia	8,828	11,762	12,748	7,692	9,667	11,662	13,795	12,192	−11.6	1.85	2.08	2.38	2.48	2.60	2.66	3.10	3.54
Washington	3,878	2,926	2,521	1,591	1,559	1,812	2,002	1,565	−21.8	.81	.52	.47	.51	.42	.41	.45	.46
West Virginia	71,254	107,900	138,519	85,609	99,179	117,926	118,646	92,922	−21.7	14.89	19.11	25.89	27.64	26.64	26.86	26.63	26.96
Wyoming	7,393	7,575	6,705	4,171	5,177	5,781	5,918	5,200	−12.1	1.55	1.34	1.25	1.35	1.39	1.32	1.33	1.51
Other States [4]	73	20	20	23	25	15	24	15	-------	.01	(1)	(1)	.01	.01	(1)	.01	.01
Total bituminous	478,435	564,565	534,989	309,710	372,373	439,088	445,531	344,630	−22.6	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	52,159	54,580	51,856	46,099	−11.1	------	------	------	------	------	------	------	------
Grand total	569,960	657,904	608,817	359,565	424,532	493,668	497,387	390,729	−21.4	------	------	------	------	------	------	------	------

[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.

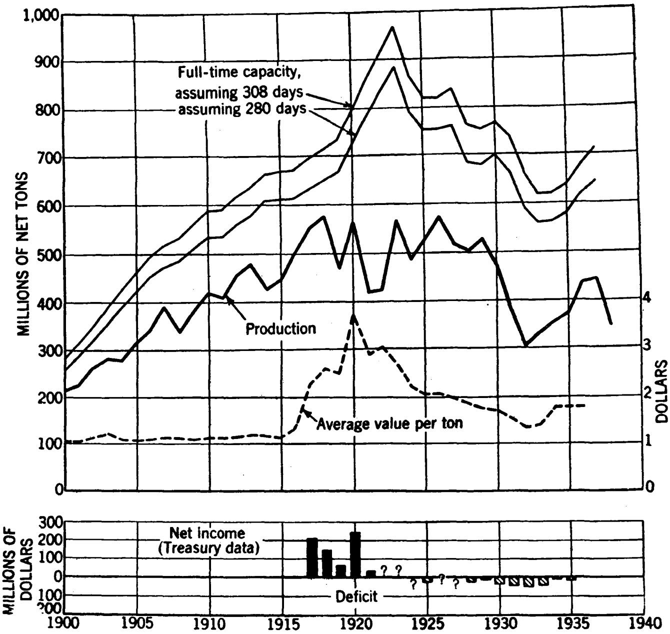

FIGURE 5.—Trends of bituminous-coal production, realization, mine capacity, and net income or deficit in the United States, 1900–1938.

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 1934–38, 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		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 [9]	2,361	40,212	1,352	69,675	1,360	44,993	180,782	340,735	9,561	930	351,226

[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, and 1937–38*

[For details and sources of data ,see Monthly Report on Distribution of Coal Shipments; tonnage figure shown in thousands of net tons]

	1923		1929		1937		1938 preliminary	
	Net tons	Percent	Net tons	Percent	Net tons	Percent	Net tons	Percent
New England receipts:								
Via rail across the Hudson	9,634	41.9	6,781	31.9	4,885	27.5	4,104	29.2
Via tidewater from Northern ports	3,703	16.1	1,570	7.4	364	2.0	125	.9
Via tidewater from Southern ports	9,671	42.0	12,875	60.7	12,553	70.5	9,808	69.9
Total New England	23,008	100.0	21,226	100.0	17,802	100.0	14,037	100.0
Tidewater loadings:								
By ports:								
At New York and Philadelphia	14,693	39.2	12,226	32.1	9,683	29.2	8,565	31.1
At Baltimore, Hampton Roads, and Charleston	22,828	60.8	25,825	67.9	23,467	70.8	19,018	68.9
Total	37,521	100.0	38,051	100.0	33,150	100.0	27,583	100.0
By fields of origin:								
From Pennsylvania and northern West Virginia	19,760	52.7	15,516	40.8	11,859	35.8	10,394	37.7
From southern low-volatile fields	13,619	36.3	17,103	44.9	16,180	48.8	13,274	48.1
From southern high-volatile fields	4,142	11.0	5,432	14.3	5,111	15.4	3,915	14.2
Total	37,521	100.0	38,051	100.0	33,150	100.0	27,583	100.0
By destination:								
To New England	13,374	35.6	14,445	38.0	12,916	39.0	9,933	36.0
Foreign	5,122	13.7	2,852	7.5	1,249	3.8	1,029	3.7
Bunkers	5,442	14.5	5,507	14.5	1,758	5.3	1,280	4.7
Inside capes and other tonnage	13,583	36.2	15,247	40.0	17,227	51.9	15,341	55.6
Total	37,521	100.0	38,051	100.0	33,150	100.0	27,583	100.0
Lake Erie loadings:								
By fields of origin (cargo and fuel):								
From Ohio	6,417	20.9	3,734	9.5	3,231	7.1	2,390	6.8
From Pittsburgh and other Pennsylvania	9,980	32.4	8,586	21.8	11,763	26.0	8,019	22.8
From Moundsville, Fairmont, Cumberland-Piedmont	3,277	10.7	2,184	5.5	2,319	5.1	1,389	4.0
From southern West Virginia, high volatile	4,994	16.2	10,233	26.0	10,975	24.3	8,329	23.7
From southern West Virginia, low volatile	2,871	9.3	7,656	19.4	8,428	18.6	7,612	21.7
From east Kentucky, Tennessee, and Virginia	3,229	10.5	6,991	17.8	8,530	18.9	7,392	21.0
Total	30,768	100.0	39,384	100.0	45,246	100.0	35,131	100.0
By destinations (cargo only):								
To American points	24,172	81.5	31,943	84.2	35,123	80.6	27,656	80.9
To Canadian points	5,475	18.5	6,007	15.8	8,479	19.4	6,510	19.1
Total	29,647	100.0	37,950	100.0	43,602	100.0	34,166	100.0
Across Lake Michigan car ferry	1,373	------	1,282	------	650	------	588	------
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	11,861	9.5	8,042	8.7
From Pennsylvania fields	15,853	10.1	21,885	13.3	15,091	12.1	9,620	10.4
From northern West Virginia and Cumberland-Piedmont	2,509	1.6	5,464	3.3	3,521	2.8	2,615	2.8
From southern West Virginia, high volatile	17,525	11.2	25,148	15.3	17,293	13.9	13,668	14.8
From southern West Virginia, low volatile	13,535	8.6	23,691	14.4	19,575	15.8	13,335	14.5
From east Kentucky, Tennessee, and Virginia	17,789	11.3	24,057	14.6	17,953	14.5	14,120	15.3
Total from Appalachian fields	90,181	57.5	113,157	68.7	85,294	68.6	61,400	66.5
From Illinois	48,401	30.9	34,863	21.2	26,625	21.4	20,719	22.5
From Indiana	14,549	9.3	10,589	6.4	10,594	8.5	8,501	9.2
From west Kentucky [1]	3,569	2.3	6,175	3.7	1,859	1.5	1,661	1.8
Total from Middle West fields	66,519	42.5	51,627	31.3	39,078	31.4	30,881	33.5
Grand total	156,700	100.0	164,784	100.0	124,372	100.0	92,281	100.0

[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.

TABLE 5.—*Trends in distribution of bituminous coal, 1923, 1929, and 1937–38*—Continued

	1923		1929		1937		1938 preliminary	
	Net tons	Percent	Net tons	Percent	Net tons	Percent	Net tons	Percent
Total shipments from other groups:								
(All shipments including in this case nonrevenue railroad fuel): [2]								
From Michigan fields	1,086	[3] 0.2	745	[3] 0.1	181	([3] [4])	150	([3] [4])
From upper Lake commercial docks, all deliveries	([5])	------	16,689	[3] 3.1	13,518	[3] 3.1	10,845	[3] 3.2
From Iowa, Missouri, Kansas	12,222	[3] 2.2	9,488	[3] 1.8	7,202	[3] 1.6	6,273	[3] 1.8
From Arkansas, Oklahoma, Texas	5,125	[3] .9	6,337	[3] 1.2	3,739	[3] .8	3,173	[3] .9
From far western fields	30,286	[3] 5.4	29,705	[3] 5.6	21,867	[3] 4.9	17,759	[3] 5.2
From Alabama field	19,569	[3] 3.5	17,503	[3] 3.3	11,771	[3] 2.7	10,177	[3] 3.0

[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 0.05 percent.
[5] Data not available.

SOURCES OF DATA AND ACKNOWLEDGMENTS

Bituminous-coal production statistics for 1938 are preliminary estimates based on (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, (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, Coal Trade Association of Indiana, 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, West Kentucky Coal Bureau, 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; the late M. J. Hartneady and his successor, 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 1938 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.

The data in this report on the output of bituminous coal in 1936 and earlier years are based on detailed annual reports of production and mine operation courteously furnished by the producers. These reports depended on the voluntary cooperation of the producing companies. The system of voluntary reporting has been in use since 1883, when these statistics were inaugurated by the Geological Survey, and has served a useful purpose in the measurement of production, supply and demand, trends of employment, mechanical equipment, operating practices, and output per man.

A combination of circumstances made it advisable for the National Bituminous Coal Commission to modify the method of compilation for 1937. On April 13, 1938, the Commission issued its Order 239, requiring all producers of bituminous coal to return a detailed accounting of the distribution of the entire production of each mine in 1937. Mines with rail or river connections were instructed to report their distribution on Commission form D-1. The form called for a statement of the tons of each individual size of coal shipped to each destination town. Mines selling only by truck reported on a simplified form known as D-2, which was adapted to their operations. This analysis of distribution was an essential prerequisite to the establishment of minimum prices under the coal act and was recognized as perhaps the most extensive task of fact-finding undertaken in the history of the bituminous-coal industry. The producers responded generously to the Commission's order, and the record of distribution developed from rail-connected mines to each ultimate destination is substantially complete.

Because of the size of the task and the great detail covered by the distribution analysis it was deemed inadvisable to require producers to prepare a separate report on production and mine operation. The items of tonnage produced had been covered on the distribution questionnaires in exceptional detail and had been rendered in each instance under affidavit of the producing company. It was therefore decided to utilize the tonnage statistics on forms D-1 and D-2 as the record of production for the year and to compile a record of employment, working time, and mechanical equipment by drawing upon the reports furnished by mine operators to the State inspection services. Nearly all of the coal-mining States require annual statistics to be filed with the local department of mines. In the few States that maintain no statistical record, other sources of information have been available. These reports, made available to the Commission in all necessary detail, have been used to assemble statistics on men employed, days operated, and tonnages produced by strip and underground mining for each coal-mining county in a form reasonably comparable with the Federal enumeration of previous years.

The aggregates and averages of men employed and working time derived in this way may differ from the corresponding figures published in the State reports for two reasons. First, the primary basis of the compilation is the tonnage record of each mine reported to the Coal Commission, against which has been matched the employment and operating record reported to the State. Although the two sources have been carefully checked for discrepancies there are differences in assignment of individual mines to districts and in the minimum size limit covered by the State and Federal enumerations that introduce discrepancies in the resulting totals. Second, the State data have in each instance been handled in a uniform manner, each step in the process of tabulating, editing, and summarizing the primary materials being taken with a view to rendering the final product as comparable as possible with the Federal series for the earlier years. Inasmuch as widely differing methods of analysis are used by the several States the uniform method followed by the authors may yield differing results.

Despite the effort at uniformity of treatment the statistician will realize that differences in the primary questionnaires used by the various States may impair the strict comparability of the employment record. The principal points of difference are discussed in the section dealing with labor statistics. Beginning with 1938 the Commission will resume collection of material for a direct report on employment, operating time, production, and mechanical equipment of the mines.

In the present chapter attention is centered on the detailed breakdown of tonnage produced according to method of shipment, which the distribution survey has made possible. For the first time figures are now available showing for each producing county the tonnage shipped to tidewater and the Great Lakes, the river movement, and the all-rail movement, the latter segregated between railroad fuel and commercial business. (See tables 6 and 39.)

Acknowledgment is made to the many individuals and agencies both public and private who have cooperated generously in making the survey possible.

FINAL BITUMINOUS STATISTICS FOR 1936 AND 1937

Tables 6 to 13, 16, 18, 24, 25, and 32–42 give the final detailed statistics of bituminous mine operations in 1937. The subjects covered include production, number and size of mines, employment, equipment and methods of preparation, fuel economy, stocks, foreign trade, and world production. Statistics for 1938, where available, have been included in these tables.

Tables 14, 15, 17, 19–23, and 26–31 relate to 1936 and show data on mechanical loading, mechanical cleaning, stripping operations, and power drilling that were not included in the detailed report for 1936 owing to space limitations.

In accordance with the practice followed by the Bureau of Mines in previous years the statistics in this report relate to mines having an output of 1,000 tons a year or more and do not attempt to include the many small mines producing less than 1,000 tons per year that sell their output by wagon or truck.

PRODUCTION

SUMMARY BY STATES

TABLE 6.—*Summary of coal produced, men employed, days operated, and output per man per day in 1937, by States*

[Exclusive of product of truck and wagon mines producing less than 1,000 tons]

State	Distribution of product—net tons										Average number of employees	Average number of days mines operated	Average tons per man per day
	Loaded at mines for shipment by rail and water						Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines [3]	Total production including inventory change and coal unaccounted for [4]			
	To tide water	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel, all-rail [2]	Total							
Alabama	350, 924	-----	81, 291	8, 045, 912	3, 282, 094	11, 760, 221	499, 903	86, 853	112, 007	12, 440, 322	22, 613	200	2. 74
Alaska	-----	-----	-----	93, 144	35, 464	128, 608	-----	4	3, 251	131, 657	123	207	5. 16
Arkansas	-----	-----	-----	1, 343, 688	121, 780	1, 465, 468	33, 376	1, 524	8, 776	1, 510, 753	4, 253	136	2. 61
Colorado	-----	-----	-----	3, 868, 313	1, 470, 179	5, 338, 492	1, 555, 973	49, 827	[3] 260, 350	7, 187, 211	9, 432	181	4. 21
Illinois	-----	-----	85, 633	27, 179, 245	15, 559, 796	42, 824, 674	7, 610, 873	203, 317	758, 386	51, 601, 638	42, 449	168	7. 25
Indiana	-----	-----	-----	10, 111, 205	5, 435, 093	15, 546, 298	1, 986, 271	28, 046	194, 666	17, 764, 774	11, 238	174	9. 10
Iowa	-----	-----	-----	1, 001, 540	729, 633	1, 731, 173	1, 833, 005	45, 237	25, 922	3, 637, 054	8, 720	146	2. 87
Kansas	-----	-----	-----	1, 716, 951	803, 215	2, 520, 166	350, 820	6, 110	15, 769	2, 892, 560	3, 574	173	4. 68
Kentucky	475, 959	9, 169, 080	245, 928	28, 963, 202	6, 362, 517	45, 216, 686	1, 304, 459	251, 759	203, 887	47, 086, 444	55, 596	192	4. 41
Maryland	132, 865	-----	-----	942, 910	207, 350	1, 283, 125	272, 393	6, 799	8, 555	1, 548, 980	2, 525	189	3. 25
Michigan	-----	-----	-----	137, 519	43, 450	180, 969	342, 857	8, 673	24, 435	562, 262	1, 343	145	2. 88
Missouri	-----	-----	-----	2, 077, 448	872, 976	2, 950, 424	1, 088, 378	15, 418	26, 701	4, 091, 394	6, 436	152	4. 18
Montana [5]	-----	-----	-----	575, 208	2, 192, 550	2, 767, 758	204, 244	8, 195	4, 275	2, 965, 193	1, 503	186	10. 62
New Mexico	-----	-----	-----	602, 088	950, 524	1, 552, 612	86, 842	10, 962	47, 418	1, 714, 955	2, 608	208	3. 17
North Dakota [5]	-----	-----	-----	1, 577, 216	-----	1, 577, 216	663, 811	-----	9, 810	2, 250, 837	1, 475	181	8. 41
Ohio	-----	3, 137, 725	730, 459	9, 609, 807	7, 314, 190	20, 792, 181	4, 183, 608	44, 488	128, 550	25, 177, 867	30, 294	185	4. 49
Oklahoma	-----	-----	-----	1, 127, 315	284, 333	1, 411, 648	168, 907	4, 558	15, 189	1, 600, 295	3, 147	142	3. 58
Pennsylvania	8, 803, 685	11, 442, 983	21, 244, 843	36, 549, 153	18, 717, 344	96, 758, 008	9, 399, 989	409, 117	[3] 4, 441, 262	111, 002, 289	133, 897	199	4. 16
South Dakota [5]	-----	-----	-----	26, 444	-----	26, 444	20, 530	-----	5	46, 979	47	165	6. 05
Tennessee	-----	190, 012	-----	2, 541, 207	2, 081, 345	4, 812, 564	289, 054	35, 729	[3] 73, 168	5, 212, 471	8, 465	195	3. 17
Texas [5]	-----	-----	-----	850, 262	11, 531	861, 793	40, 041	49	8, 704	910, 352	819	199	5. 59
Utah	12, 180	-----	-----	2, 714, 436	773, 787	3, 500, 403	286, 410	18, 859	[3] 18, 353	3, 809, 476	3, 417	189	5. 88
Virginia	2, 007, 108	1, 543, 619	-----	7, 388, 313	2, 077, 975	13, 017, 015	246, 228	79, 980	[3] 450, 726	13, 795, 239	16, 494	200	4. 18

Washington	16,385	----------	----------	910,833	517,806	1,445,024	470,851	18,359	21,199	2,001,449	2,882	204	3.40
West Virginia	19,919,591	18,628,479	5,421,922	55,006,125	15,251,387	114,227,504	2,531,248	686,753	[3] 948,899	118,646,343	113,643	209	5.00
Wyoming	----------	----------	----------	1,325,730	4,204,500	5,530,230	222,544	36,290	125,554	5,918,359	4,743	204	6.11
Other States [6]	----------	----------	----------	5,751	5,120	10,871	13,091	----------	334	24,296	128	165	1.15
	31,718,697	44,111,898	27,810,076	206,290,965	89,305,939	399,237,575	35,705,706	2,056,906	[3] 7,936,149	445,531,449	491,864	193	4.69

[1] Includes coal reported as "shipped to distributors, destinations unknown," a small part of which may have been forwarded to tidewater or Great Lakes.
[2] Includes coal taken by locomotives at tipple.
[3] Includes coal made into beehive coke at mines in the following States in 1937: Colorado, 115,278; Pennsylvania, 3,787,102; Tennessee, 26,560; Utah, 12,271; Virginia, 412,192; West Virginia, 530,651 (including a small amount of coal made into briquets); a grand total of 4,884,054 tons in 1937, against 2,728,577 in 1936. Does not include coal shipped in by rail or truck from mines to beehive ovens for coking, such tonnage being included under rail or truck deliveries.
[4] 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.
[5] Includes figures on lignite from Bureau of Mines; see Lignite Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
[6] Arizona, California, Georgia, Idaho, and Oregon.

TOTAL PRODUCTION SINCE BEGINNING OF MINING

TABLE 7.—*Coal produced, 1927–37, by States, with production of maximum year and cumulative production from the earliest record to the end of 1937, in thousands of net tons*

State	Maximum production		Production by years											Total production from earliest record to end of 1937
	Year	Quantity	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	
Alabama	1926	21, 001	19, 766	17, 621	17, 944	15, 570	11, 999	7, 857	8, 760	9, 142	8, 505	12, 229	12, 440	627, 966
Arkansas	1907	2, 670	1, 549	1, 661	1, 695	1, 533	1, 154	1, 033	883	857	1, 133	1, 623	1, 511	72, 344
Colorado	1917	12, 483	9, 724	9, 848	9, 921	8, 197	6, 604	5, 599	5, 230	5, 211	5, 911	6, 812	7, 187	391, 259
Georgia	1903	416	77	58	45	7	22	27	41	33	(1)	(1)	(1)	(1)
Illinois	1918	89, 291	46, 848	55, 948	60, 658	53, 731	44, 303	33, 475	37, 413	41, 272	44, 525	50, 927	51, 602	2, 405, 891
Indiana	1918	30, 679	17, 936	16, 379	18, 344	16, 490	14, 295	13, 324	13, 761	14, 794	15, 754	17, 822	17, 765	721, 090
Iowa	1917	8, 966	2, 950	3, 684	4, 241	3, 893	3, 388	3, 862	3, 195	3, 367	3, 650	3, 961	3, 637	308, 739
Kansas	1918	7, 562	3, 444	2, 810	2, 976	2, 430	1, 987	1, 953	2, 218	2, 508	2, 686	2, 944	2, 893	229, 064
Kentucky	1927	69, 124	69, 124	61, 860	60, 463	51, 209	39, 964	35, 300	36, 100	38, 525	40, 761	47, 522	47, 086	1, 209, 969
Maryland	1907	5, 533	2, 815	2, 687	2, 649	2, 271	2, 006	1, 429	1, 531	1, 627	1, 678	1, 704	1, 549	239, 947
Michigan	1907	2, 036	757	617	805	661	359	446	407	622	628	626	562	43, 916
Missouri	1917	5, 671	3, 064	3, 733	4, 030	3, 853	3, 621	4, 070	3, 432	3, 352	3, 646	3, 985	4, 091	212, 286
Montana	1918	4, 533	3, 144	3, 324	3, 408	3, 022	2, 378	2, 125	2, 152	2, 566	2, 759	2, 988	2, 965	115, 068
New Mexico	1918	4, 023	2, 935	2, 712	2, 623	1, 969	1, 553	1, 263	1, 226	1, 259	1, 389	1, 597	1, 715	104, 770
North Carolina	1922	79	53	61	52	29	2	2	2	3	(1)	(1)	(1)	(1)
North Dakota	1937	2, 251	1, 528	1, 650	1, 862	1, 700	1, 519	1, 740	1, 782	1, 754	1, 956	2, 215	2, 251	37, 823
Ohio	1920	45, 878	15, 800	15, 641	23, 689	22, 552	20, 411	13, 909	19, 589	20, 691	21, 153	24, 110	25, 178	1, 335, 547
Oklahoma	1920	4, 849	3, 818	3, 501	3, 774	2, 794	1, 908	1, 255	1, 238	1, 208	1, 229	1, 540	1, 600	129, 030
Pennsylvania bituminous	1918	178, 551	132, 965	131, 202	143, 516	124, 463	97, 659	74, 776	79, 296	89, 826	91, 405	109, 887	111, 002	5, 888, 186
Tennessee	1910	7, 121	5, 783	5, 611	5, 405	5, 130	4, 721	3, 538	3, 775	4, 136	4, 138	5, 108	5, 213	250, 197
Texas	1913	2, 429	1, 326	1, 182	1, 101	834	716	637	822	759	758	843	910	57, 363
Utah	1920	6, 005	4, 781	4, 843	5, 161	4, 258	3, 350	2, 852	2, 675	2, 406	2, 947	3, 247	3, 810	131, 604
Virginia	1926	14, 133	12, 916	11, 901	12, 748	10, 907	9, 699	7, 692	8, 179	9, 377	9, 667	11, 662	13, 795	349, 074
Washington	1918	4, 082	2, 635	2, 520	2, 521	2, 302	1, 846	1, 591	1, 394	1, 383	1, 559	1, 812	2, 002	125, 111
West Virginia	1927	145, 122	145, 122	132, 952	138, 519	121, 473	101, 473	85, 609	94, 344	98, 134	99, 179	117, 926	118, 646	3, 250, 331
Wyoming	1920	9, 630	6, 754	6, 572	6, 705	6, 088	4, 994	4, 171	4, 013	4, 368	5, 177	5, 781	5, 918	275, 656
Other States			149	167	134	160	158	175	173	188	180	217	203	61, 458
Total bituminous			517, 763	500, 745	534, 989	467, 526	382, 089	309, 710	333, 631	359, 368	372, 373	439, 088	445, 531	18, 573, 689
Pennsylvania anthracite	1917	99, 612	80, 096	75, 348	73, 828	69, 385	59, 646	49, 855	49, 541	57, 168	52, 159	54, 580	51, 856	4, 236, 358
Grand total			597, 859	576, 093	608, 817	536, 911	441, 735	359, 565	383, 172	416, 536	424, 532	493, 668	497, 387	22, 810, 047

[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 Commission's 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 8.—*Estimated weekly production of bituminous coal in 1937*

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. 2	[1] 1,482,000	[1] 1.1	[2] 1,792,000	July 10	6,575,000	5	1,315,000
Jan. 9	10,947,000	6	1,825,000	July 17	7,250,000	6	1,208,000
Jan. 16	10,600,000	6	1,767,000	July 24	7,403,000	6	1,234,000
Jan. 23	9,570,000	6	1,595,000	July 31	7,837,000	6	1,306,000
Jan. 30	8,839,000	6	1,473,000	Aug. 7	7,478,000	6	1,246,000
Feb. 6	10,018,000	6	1,670,000	Aug. 14	7,738,000	6	1,290,000
Feb. 13	10,305,000	6	1,718,000	Aug. 21	7,715,000	6	1,286,000
Feb. 20	10,990,000	6	1,832,000	Aug. 28	8,058,000	6	1,343,000
Feb. 27	11,348,000	5.9	1,923,000	Sept. 4	8,580,000	6	1,430,000
Mar. 6	11,240,000	6	1,873,000	Sept. 11	7,863,000	5	1,573,000
Mar. 13	11,435,000	6	1,906,000	Sept. 18	9,249,000	6	1,542,000
Mar. 20	11,365,000	6	1,894,000	Sept. 25	9,620,000	6	1,603,000
Mar. 27	11,503,000	6	1,917,000	Oct. 2	9,826,000	6	1,638,000
Apr. 3	7,241,000	5.2	1,393,000	Oct. 9	9,704,000	6	1,617,000
Apr. 10	5,860,000	6	977,000	Oct. 16	9,867,000	6	1,645,000
Apr. 17	6,380,000	6	1,063,000	Oct. 23	9,680,000	6	1,613,000
Apr. 24	6,705,000	6	1,118,000	Oct. 30	9,347,000	6	1,558,000
May 1	6,922,000	6	1,154,000	Nov. 6	8,947,000	6	1,491,000
May 8	7,014,000	6	1,169,000	Nov. 13	9,032,000	5.5	1,642,000
May 15	7,269,000	6	1,212,000	Nov. 20	8,231,000	6	1,372,000
May 22	7,422,000	6	1,237,000	Nov. 27	7,520,000	5	1,504,000
May 29	7,598,000	6	1,266,000	Dec. 4	8,320,000	6	1,387,000
June 5	6,696,000	5.3	1,263,000	Dec. 11	10,346,000	6	1,724,000
June 12	7,090,000	6	1,182,000	Dec. 18	9,139,000	6	1,523,000
June 19	7,178,000	6	1,196,000	Dec. 25	6,405,000	5	1,281,000
June 26	7,233,000	6	1,206,000	Jan. 1	[1] 6,176,000	[1] 5	[2] 1,221,000
July 3	7,375,000	6	1,229,000				
					445,531,000	306.0	1,456,000

[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 2, 1937, was 9,141,000 net tons; for the week of January 1, 1938, 6,225,000.

[2] Average daily production for the entire week and not for the working days in the calendar year shown.

Table 9.—*Monthly production of coal in 1937, by States, in thousands of net tons*

[The totals for the year are based on final complete returns to the National Bituminous Coal Commission 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	1,193	1,204	1,453	116	781	1,053	1,123	1,104	1,106	1,109	1,043	1,155	12,440
Alaska	9	8	9	12	10	13	12	11	13	14	8	13	132
Arkansas	247	154	75	8	9	12	79	149	183	217	157	221	1,511
Colorado	946	825	771	302	365	363	337	405	585	708	729	851	7,187
Illinois	5,695	5,789	6,967	2,114	2,239	2,674	2,939	3,230	4,377	5,030	4,897	5,651	51,602
Indiana	1,671	1,943	2,358	691	1,008	1,110	1,052	1,137	1,519	1,583	1,642	2,051	17,765
Iowa	499	504	542	78	97	90	115	217	317	369	382	427	3,637
Kansas	349	327	392	26	132	165	177	237	239	259	270	320	2,893
Kentucky:													
Eastern	2,790	2,580	4,100	3,018	3,278	3,086	3,010	3,054	3,658	3,733	3,168	3,048	38,523
Western	695	669	1,278	423	498	520	539	597	739	807	800	998	8,563
Maryland	162	161	193	78	76	107	110	121	132	141	138	130	1,549
Michigan	80	88	84	10	4	13	18	26	52	59	60	68	562
Missouri	515	473	524	191	171	167	186	225	317	382	390	550	4,091
Montana	330	308	316	125	130	166	175	193	258	326	337	301	2,965
New Mexico	182	185	191	125	113	121	133	123	132	144	129	137	1,715
North Dakota	321	315	200	90	61	59	56	77	182	298	288	304	2,251
Ohio	2,261	2,528	2,957	1,334	1,891	1,922	1,750	1,792	2,196	2,315	2,156	2,076	25,178
Oklahoma	191	161	162	27	40	58	64	134	139	222	182	220	1,600
Pennsylvania bituminous	10,352	10,956	12,997	7,611	8,204	8,643	8,628	8,907	9,722	9,594	7,963	7,425	111,002
South Dakota	9	7	3	1	2	1	2	2	4	6	4	6	47
Tennessee	470	467	588	173	368	437	425	423	463	483	492	424	5,213
Texas	61	63	69	63	67	78	86	91	92	83	77	80	910
Utah	525	495	442	137	118	153	187	248	347	394	354	410	3,810
Virginia	1,188	1,155	1,516	735	1,007	1,023	1,073	1,173	1,294	1,384	1,145	1,102	13,795
Washington	239	225	177	125	125	145	132	136	156	184	178	180	2,002
West Virginia	9,766	10,422	12,975	8,311	9,210	9,447	9,456	9,972	10,677	10,633	9,136	8,641	118,646
Wyoming	689	646	593	288	266	361	319	402	527	631	571	625	5,918
Other States [1]	3	3	3	1	1	1	1	1	2	2	3	3	24
Total bituminous coal	41,438	42,661	51,935	26,213	30,271	31,988	32,184	34,187	39,428	41,110	36,699	37,417	445,531
Pennsylvania anthracite [2]	4,236	3,671	4,795	6,779	4,361	4,635	2,748	2,903	3,682	4,848	4,439	4,759	51,856
Grand total	45,674	46,332	56,730	32,992	34,632	36,623	34,932	37,090	43,110	45,958	41,138	42,176	497,387

[1] Arizona, California, 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.

NUMBER AND SIZE OF MINES

The 1937 survey of the bituminous-coal industry is based on records of 6,548 mines that produced 1,000 tons or more during the year. Although this is somewhat less than the 6,875 mines in the 1936 survey it is more than in any other year since 1927. The upward trend in the number of mines from the low of 5,427 in 1932 has been due in considerable measure to the opening of small truck mines in sections that have gained access to markets through the development of hard roads and cheap motor transport. The increase has been influenced by the presence of unemployed miners seeking a means of livelihood within their own trade. Furthermore, part of the rise in the number of mines resulted from the more intensive enumeration of small producers by both State and Federal agencies in recent years. This applies especially to 1936, when data on the production of numerous small mines were drawn from the code acceptance records.

The regulatory functions of the National Bituminous Coal Commission made it necessary to prepare a list of all coal producers, regardless of size, down to the smallest wagon mine or country bank. The list compiled originally has been revised from time to time in accordance with the latest information from the field. A total of 11,612 code acceptances was on file June 10, 1939, with the names of 4,303 supposed producers who had not applied for code membership. Many of the latter undoubtedly represent coal banks no longer in operation or are carried in the list of code members under another name. Although a majority of the nominal total of 15,915 producers have an output of less than 1,000 tons a year the record discloses a number of mines above the 1,000-ton limit that have not been listed previously by either Federal or State mine departments. Since the code acceptances included reports of the code members' output in 1936 they served as a supplementary record of production for that year. Some of the small mines that were added to the 1936 production on the basis of these records, however, did not furnish any data for 1937, so that the count for the latter year is slightly less complete.

The Federal enumerations for 1936 and 1937 were supplemented by increasing attention to statistics of small mines by certain State mine departments, such as those of Alabama, Indiana, Pennsylvania, and West Virginia.

The change in coverage of small mines, however, affects the comparability of the record only as far as the number of mines is concerned. Although nearly 60 percent of all mines included in the 1937 report fell in the less than 10,000 tons per year class the combined production for this group was less than 3 percent of the total for the country; consequently the change in the number of mines has very little effect upon comparability of the tonnage figures.

TABLE 10.—*Number and production of commercial bituminous-coal mines in the United States in 1937,*[1] *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	State total
Alabama	8	4,975,061	9	2,634,763	18	2,480,505	20	1,586,995	16	364,127	123	398,871	194	12,440,322
Alaska							1	81,474	1	45,142	2	5,041	4	131,657
Arkansas							8	486,371	38	910,349	34	114,033	80	1,510,753
Colorado	1	545,807	6	1,348,267	19	2,791,196	15	1,043,194	49	999,189	148	459,558	238	7,187,211
Illinois	33	28,200,482	36	12,985,292	23	3,209,329	41	2,929,415	125	2,990,118	401	1,287,002	659	51,601,638
Indiana	9	6,394,334	18	5,397,259	17	2,351,419	21	1,506,771	71	1,556,262	136	558,729	272	17,764,774
Iowa			2	520,705	1	178,524	11	884,698	55	1,239,475	271	813,652	340	3,637,054
Kansas			4	1,076,423	4	667,493	5	364,266	20	476,566	123	307,812	156	2,892,560
Kentucky:														
Eastern	15	11,998,407	43	13,664,936	50	7,196,526	52	3,787,404	58	1,589,764	117	286,517	335	38,523,554
Western	1	553,544	14	3,821,240	18	2,305,320	11	825,916	32	785,114	84	271,756	160	8,562,890
Maryland					3	480,027	5	377,509	19	506,417	63	185,027	90	1,548,980
Michigan					1	167,234	3	212,085	8	176,916	3	6,027	15	562,262
Missouri	1	547,417	5	1,387,049	1	173,516	7	476,926	41	923,809	208	582,677	263	4,091,394
Montana, North Dakota, South Dakota, and Texas [2]	1	1,247,337	8	2,578,476	6	995,829	4	282,476	27	544,511	263	524,732	309	6,173,361
New Mexico			2	666,975	4	595,438	5	281,209	5	91,975	33	79,358	49	1,714,955
Ohio	13	9,834,120	20	6,498,124	23	3,364,064	23	1,706,141	99	2,203,757	558	1,571,661	736	25,177,867
Oklahoma					2	382,234	6	399,561	23	594,636	74	223,864	105	1,600,295
Pennsylvania	59	51,948,250	89	28,053,680	109	15,549,713	93	7,173,797	261	5,753,624	726	2,523,225	1,337	111,002,289
Tennessee			8	2,147,497	13	1,716,196	10	677,352	20	468,863	79	202,563	130	5,212,471
Utah			7	2,089,164	6	811,043	8	574,153	8	224,757	31	110,359	60	3,809,476
Virginia	6	4,224,801	20	5,634,904	14	2,106,736	17	1,221,690	15	470,325	55	136,783	127	13,795,239
Washington			3	749,087	4	620,391	1	66,457	16	430,453	35	135,061	59	2,001,449
West Virginia	62	45,519,753	148	45,591,236	126	18,870,684	74	5,528,553	99	2,411,464	245	724,653	754	118,646,343
Wyoming	3	1,671,087	7	2,167,742	7	1,138,780	7	546,309	10	306,829	31	87,612	65	5,918,359
Other States [3]									1	11,205	10	13,091	11	24,296
Grand total	212	167,660,400	449	139,012,819	469	68,152,197	448	33,020,722	1,117	26,075,647	3,853	11,609,664	6,548	445,531,449

[1] As in 1935 and 1936, the 1937 figures of total number of mines and of number in class 5 (less than 10,000 tons) are not comparable with years before 1934 in a number of States because of more complete coverage of small trucking mines (producing more than 1,000 tons per year). See Minerals Yearbook, 1936, pp. 561–564.
[2] Includes lignite figures from Bureau of Mines.
[3] Arizona, California, Georgia, Idaho, and Oregon.

TREND OF AVERAGE VALUE PER TON, F. O. B. MINES, 1929 TO 1937

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 bituminous 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 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 11.—*Trend of average value per ton, f. o. b. mines, 1929–37*

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

[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 on posted prices of larger producers, and oftentimes represent "asked" rather than "actual" prices.

Spot prices are not to be confused with sales realization, since 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 and 1938.

TABLE 12.—*Trend of spot prices of bituminous coal per net ton, f. o. b. mines as indicated by trade journal quotations, 1937–38* [1]

[Based on 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 three 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 2 years]

Month	Prepared sizes			Run-of-mine			Screenings or slack			All coal		
	1937	1938	Change from 1937 [2]	1937	1938	Change from 1937 [2]	1937	1938	Change from 1937 [2]	1937	1938	Change from 1937 [2]
January [3]	$2.49	$2.58	+$0.09	$2.06	$2.22	+$0.16	$1.49	$1.81	+$0.32	$2.07	$2.25	+$0.18
February [3]	2.49	2.54	+.05	2.07	2.21	+.14	1.54	1.77	+.23	2.09	2.22	+.13
March	2.39	2.48	+.09	2.06	2.07	+.01	1.70	1.50	−.20	2.09	2.08	−.01
April	2.30	2.22	−.08	2.11	2.08	−.03	1.77	1.51	−.26	2.09	1.99	−.10
May	2.30	2.21	−.09	2.13	2.07	−.06	1.77	1.51	−.26	2.10	1.96	−.14
June [3]	2.29	2.22	−.07	2.13	2.07	−.06	1.77	1.51	−.26	2.09	1.97	−.12
July	2.33	2.23	−.10	2.07	2.07	--------	1.74	1.47	−.27	2.08	1.96	−.12
August	2.38	2.28	−.10	2.10	2.06	−.04	1.72	1.41	−.31	2.11	1.96	−.15
September	2.39	2.34	−.05	2.10	2.10	--------	1.64	1.37	−.27	2.09	1.98	−.11
October	2.44	2.47	+.03	2.10	2.10	--------	1.60	1.38	−.22	2.10	2.04	−.06
November	2.45	2.45	--------	2.11	2.07	−.04	1.59	1.33	−.26	2.10	2.01	−.09
December [3]	2.49	2.43	−.06	2.16	2.06	−.10	1.71	1.34	−.37	2.17	2.00	−.17
Average:												
12 months	2.40	2.37	−.03	2.10	2.10	--------	1.67	1.49	−.18	2.10	2.04	−.06
9 months (April to December)	2.37	2.32	−.05	2.11	2.08	−.03	1.70	1.43	−.27	2.10	1.99	−.11

[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] The increase in miners' wages after April 1, 1937, and the higher level of minimum prices during January and February 1938 must be taken into consideration when comparing prices for the first 3 months of 1937 and 1938.

[3] No quotations for Cleveland or Pittsburgh in January and February, or for Pittsburgh in June and December.

LABOR STATISTICS

MEN EMPLOYED

An average of 491,864 men was employed at bituminous-coal mines in 1937, an increase of 3 percent over the reported total of 477,204 for 1936. (See fig. 6.)

In general, these figures of average numbers employed represent the normal working force on the rolls of the mine during periods of active operation. The factor of intermittent employment, so characteristic of coal mining, has a marked effect on the earnings of the men, but it can best be treated by maintaining a separate record of the number of days operated during the year.

As outlined in the section "Sources of Data and Acknowledgments." the National Bituminous Coal Commission did not make a direct canvass of employment in the coal industry in 1937. All employment data in this report have been abstracted from records compiled by the various State departments of mines and other sources. Although the schedules that these agencies used in collecting the original data differed in many respects and although none were identical with the standard form used by the Bureau of Mines for the 1935 and by the Commission for the 1936 surveys the results for 1937 in general are fairly comparable with similar data in previous reports.

Among the problems encountered was classification of beehive-coke workers and office force. The standard schedule previously used by the Bureau of Mines had directed that these occupations be excluded. The State schedules for 1937 treated them in various ways. Some States followed the Federal practice and directed that coke and office workers be excluded. Others directed that they be reported. Where such was the practice an effort was made to deduct them from the total working force of the mine in question, and this could be done for Ohio and West Virginia, the figures for West Virginia excluding also supervisory officials. In Pennsylvania coke workers were deducted but office employees could not be. In Illinois, also, office employees were not eliminated. Several of the States, however, gave no specific instructions as to the occupations to be returned. It appears therefore that the employment figures in the present report may have a slight upward bias, due to the inclusion in some States of workers not

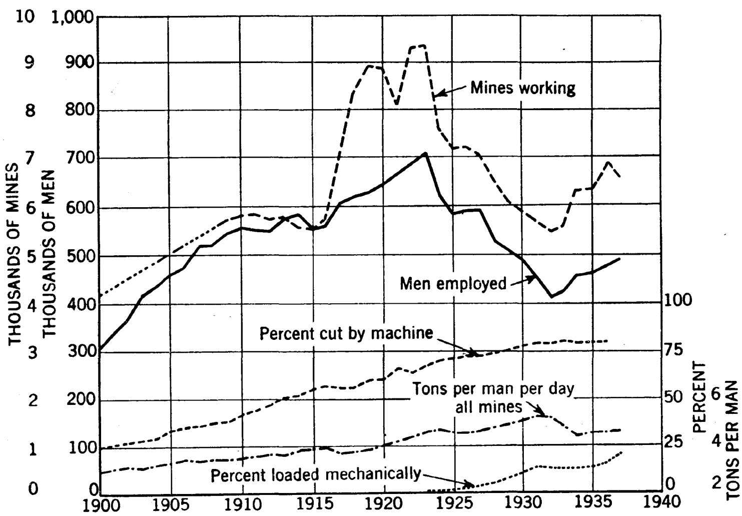

FIGURE 6.—Trends of employment, mechanization, and output per man at bituminous-coal mines, 1900–1937.

actually engaged in mining. The number so included is unimportant. The manufacture of beehive coke has shrunk to small proportions and outside of Pennsylvania and West Virginia, where coke workers are excluded, is confined to a few mines only. The number of office workers is small. In Ohio, for example, they comprised 0.9 percent of all employees. In West Virginia, where an occupational break-down is available, coke workers, office, and supervisory employees combined amounted to only 2.5 percent of all coal-mine employees.

The questionnaire for 1936 called for the number of men employed at each of the 12 pay periods nearest the fifteenth of the month. The average number of employees could then be computed accurately, excluding any pay periods when the mines were shut down and were giving employment only to maintenance men. Since employment data by months were procured by only a few of the States the former method of obtaining annual averages could not be used in the 1937 report. As a consequence of these as well as other differences comparisons between the employment data for 1937 and similar data for earlier years must be made with qualifications.[3]

In recent years a special problem has arisen in recording of 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 Department of Mines and Minerals in Illinois in 1937 indicated that 53 mines 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 7 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 1937; 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 for bituminous-coal mines in 1937 was 193.[4] This represents a slight decline from the average of 199 days for 1936. 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 without regard to 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-mine operations, however, keep an accurate record of the man-days or man-hours worked. Consequently, man-days have been computed by multiplying the

[3] The statistical problems of measuring employment are fully discussed in two studies published by the Works Progress Administration, National Research Project on Reemployment Opportunities and Recent Changes in Industrial Techniques: Employment and Related Statistics of Mines and Quarries, 1935, Part I, Bituminous Coal, by F. G. Tryon and others, pp. 12-17; Mechanization, Employment, and Output Per Man in Bituminous-Coal Mining, by Willard E. Hotchkiss and others.

[4] Derived from the reports submitted by individual mines to the State inspection departments or other sources drawn upon. It is believed that a uniform return upon the standard questionnaire used by the Bureau of Mines in earlier years would show a slightly higher result, probably, 194 days. For practical purposes, however, the 1937 figures are comparable.

number of workers employed by the number of operating days. Although these computations were made for each individual mine the combined total is necessarily an approximation.

Until the American coal industry arranges to keep an accurate record of the 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 1937 indicate that bituminous-coal-mine employees performed 95,015,641 man-days of labor during the year. Table 6 gives a summary record of men employed, days operated, and output per man per day at bituminous-coal mines by States in 1937. Details by counties for 1937 are shown in table 39. Comparisons between 1937 and earlier years, however, are subject to the limitations imposed by the diversity of the schedules that the various agencies used in collecting the original data.

LENGTH OF WORKING DAY

Data for computing the number of hours in the average working day of bituminous-coal miners were not available for 1937. Since 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. For further discussion of length of working day and detailed statistics of earlier years, see Minerals Yearbook, 1937, pages 821–823.

EQUIPMENT AND METHODS OF MINING AND PREPARATION, 1936–38

Statistics of strip mining, machine cutting, mechanical loading, and mechanical cleaning for 1936 were omitted from Minerals Yearbook, 1938, because of lack of space. To maintain the continuity of the series and to provide a permanent record of the essential data it seems advisable, therefore, to include the 1936 tables on equipment, methods of mining, and preparation in the following section along with such data for 1937 and 1938 as are now available.

TABLE 13.—*Bituminous coal mined from underground workings and strip pits, 1936–37, by States*

State	Net tons						Percent					
	1936			1937			1936			1937		
	Underground	Strip	Total	Underground	Strip	Total	Underground	Strip	Total	Underground	Strip	Total
Alabama	12, 177, 133	52, 154	12, 229, 287	12, 404, 054	36, 268	12, 440, 322	99. 6	0. 4	100. 0	99. 7	0. 3	100. 0
Alaska	136, 593		136, 593	131, 657		131, 657	100. 0		100. 0	100. 0		100. 0
Arkansas	1, 567, 672	55, 115	1, 622, 787	1, 482, 281	28, 472	1, 510, 753	96. 6	3. 4	100. 0	98. 1	1. 9	100. 0
Illinois	41, 813, 930	9, 112, 669	50, 926, 599	40, 152, 906	11, 448, 732	51, 601, 638	82. 1	17. 9	100. 0	77. 8	22. 2	100. 0
Indiana	10, 142, 735	7, 679, 801	17, 822, 536	9, 483, 772	8, 281, 002	17, 764, 774	56. 9	43. 1	100. 0	53. 4	46. 6	100. 0
Iowa	3, 688, 166	272, 534	3, 960, 700	3, 218, 103	418, 951	3, 637, 054	93. 1	6. 9	100. 0	88. 5	11. 5	100. 0
Kansas	918, 314	2, 025, 714	2, 944, 028	925, 909	1, 966, 651	2, 892, 560	31. 2	68. 8	100. 0	32. 0	68. 0	100. 0
Maryland	1, 703, 589		1, 703, 589	1, 548, 980		1, 548, 980	100. 0		100. 0	100. 0		100. 0
Michigan	626, 145		626, 145	562, 262		562, 262	100. 0		100. 0	100. 0		100. 0
Missouri	1, 524, 250	2, 460, 749	3, 984, 999	1, 437, 227	2, 654, 167	4, 091, 394	38. 2	61. 8	100. 0	35. 1	64. 9	100. 0
Montana and Texas [1]	2, 518, 453	1, 312, 695	3, 831, 148	2, 539, 634	1, 335, 911	3, 875, 545	65. 7	34. 3	100. 0	65. 5	34. 5	100. 0
New Mexico	1, 596, 775		1, 596, 775	1, 714, 955		1, 714, 955	100. 0		100. 0	100. 0		00. 0
North Dakota [1]	848, 414	1, 366, 921	2, 215, 335	903, 482	1, 347, 355	2, 250, 837	38. 3	61. 7	100. 0	40. 1	59. 9	00. 0
Ohio	21, 651, 962	2, 458, 116	24, 110, 078	22, 709, 243	2, 468, 624	25, 177, 867	89. 8	10. 2	100. 0	90. 2	9. 8	100. 0
Oklahoma	1, 196, 705	343, 598	1, 540, 303	1, 134, 360	465, 935	1, 600, 295	77. 7	22. 3	100. 0	70. 9	29. 1	100. 0
Pennsylvania	109, 133, 686	753, 784	109, 887, 470	110, 148, 345	853, 944	111, 002, 289	99. 3	. 7	100. 0	99. 2	. 8	100. 0
South Dakota [1]	7, 814	33, 517	41, 331	4, 885	42, 094	46, 979	18. 9	81. 1	100. 0	10. 4	89. 6	100. 0
Tennessee	5, 108, 195		5, 108, 195	5, 212, 471		5, 212, 471	100. 0		100. 0	100. 0		100. 0
Utah	3, 246, 565		3, 246, 565	3, 809, 476		3, 809, 476	100. 0		100. 0	100. 0		100. 0
Virginia	11, 661, 636		11, 661, 636	13, 795, 239		13, 795, 239	100. 0		100. 0	100. 0		100. 0
Washington	1, 812, 104		1, 812, 104	2, 001, 449		2, 001, 449	100. 0		100. 0	100. 0		100. 0
Wyoming	5, 637, 896	142, 694	5, 780, 590	5, 750, 560	167, 799	5, 918, 359	97. 5	2. 5	100. 0	97. 2	2. 8	100. 0
Other States [2]	172, 243, 314	55, 796	172, 299, 110	172, 709, 346	234, 948	172, 944, 294	100. 0	([3])	100. 0	99. 9	. 1	100. 0
Grand total	410, 962, 046	28, 125, 857	439, 087, 903	413, 780, 596	31, 750, 853	445, 531, 449	93. 6	6. 4	100. 0	92. 9	7. 1	100. 0

[1] Includes lignite figures from Bureau of Mines.
[2] Arizona, California, Colorado, Georgia, Idaho, Kentucky, Oregon, and West Virginia; individual figures for strip mining for these States cannot be revealed.
[3] Less than 0.05 percent.

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STRIPPING OPERATIONS IN 1936 AND 1937

TABLE 14.—*Stripping operations of all types in bituminous-coal fields in 1936, by States and counties*

[Returns for mines that recover coal both by stripping and by underground operations do not permit separating men engaged in stripping from those engaged in other work. For this reason the figures of men employed represent all persons working at these mines, including those underground. The total tons produced by both methods at these same mines are also shown]

State and county	Number of strip pits	Number of power shovels: Steam	Number of power shovels: Electric	Number of power shovels: All others	Coal produced (net tons): Mined by stripping	Coal produced (net tons): Total at same mines	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	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
Alabama: Blount and Walker	5	10		2	52,154	54,101	2	157	20	179	81	[1] 2.0	14,430	3.75
Illinois:														
Bureau, Henry, Jackson, Jefferson, Knox, Randolph, and Schuyler	7		10	1	1,167,785	1,167,785		275	246	521	158	32.7	82,071	14.23
Fulton	9		16	4	2,051,372	2,051,372		271	270	541	206	77.1	111,231	18.44
Grundy	5			5	87,196	87,196		76	16	92	94	53.9	8,602	10.14
La Salle	13		1	12	204,850	204,850		132	49	181	157	36.6	28,346	7.23
Perry	4	3	16	1	2,411,133	2,411,133		488	226	714	207	71.9	147,674	16.33
St. Clair	5		2	7	384,053	384,053		61	44	105	167	13.2	17,584	21.84
Saline	4	2	4	1	455,367	455,367		133	66	199	136	12.4	27,150	16.77
Vermilion	3	2		3	144,508	144,508		62	20	82	163	6.2	13,383	10.80
Will	3		10	6	1,483,027	1,483,027		292	158	450	243	100.0	109,193	13.58
Williamson	9	1	3	7	723,378	723,378		119	84	203	187	24.6	37,958	19.06
Total Illinois	62	8	62	47	9,112,669	9,112,669		1,909	1,179	3,088	189	17.9	583,192	15.63
Indiana:														
Clay	23	14	4	24	888,936	888,936		414	163	577	155	82.5	89,244	9.96
Fountain, Knox, and Owen	6	2	1	8	231,746	231,746		117	27	144	175	10.4	25,262	9.17
Greene	14	10	6	6	1,135,194	1,135,194		335	167	502	144	61.3	72,115	15.74
Pike	7	4	12	6	2,842,070	2,842,070		574	284	858	193	91.0	165,935	17.13
Sullivan	4	4	3	5	454,156	454,156		132	95	227	142	20.2	32,145	14.13
Vigo	5	3	4	1	1,101,071	1,101,071		364	134	498	218	30.9	108,510	10.15
Warrick	6	2	4	9	1,026,628	1,026,628		215	143	358	210	78.7	75,168	13.66
Total Indiana	65	39	34	59	7,679,801	7,679,801		2,151	1,013	3,164	180	43.1	568,379	13.51

Iowa:														
Davis, Greene, Keokuk, Van Buren, Warren, and Webster	10	1	2	5	80, 864	80, 864		82	25	107	119	29. 0	12, 779	6. 33
Mahaska	7			8	87, 477	87, 477		76	15	91	113	57. 4	10, 259	8. 53
Marion	8			7	104, 193	104, 193		69	14	83	173	28. 4	14, 320	7. 28
Total Iowa	25	1	2	20	272, 534	272, 534		227	54	281	133	[1] 34. 2	37, 358	7. 30
Kansas:														
Bourbon	6	3		2	23, 998	23, 998		33	7	40	161	100. 0	6, 420	3. 74
Cherokee	3	1	2	1	268, 938	268, 938		67	34	101	154	80. 7	15, 600	17. 24
Coffey, Franklin, and Linn	5			4	17, 123	17, 123		46	9	55	96	33. 0	5, 299	3. 23
Crawford	24	20	11	5	1, 689, 037	1, 689, 037		636	173	809	166	72. 1	134, 614	12. 55
Labette	5	2		3	14, 494	14, 494		24	5	29	139	100. 0	4, 042	3. 59
Osage	12			2	12, 124	12, 124		80	15	95	68	13. 5	6, 457	1. 88
Total Kansas	55	26	13	17	2, 025, 714	2, 025, 714		886	243	1, 129	153	68. 8	172, 432	11. 75
Missouri:														
Barton	7	4	7	2	745, 475	745, 475		160	63	223	197	98. 9	43, 836	17. 01
Bates	3	4	4	1	708, 944	708, 944		178	96	274	175	97. 2	47, 819	14. 83
Boone, Callaway, Dade, Jasper, Johnson, Randolph, and Warren	8	3	3	5	381, 980	381, 980		113	26	139	202	61. 0	28, 033	13. 63
Henry	6	6	5		538, 473	538, 473		218	63	281	173	95. 9	48, 696	11. 06
Vernon	3	3	1		85, 877	85, 877		44	11	55	220	70. 5	12, 094	7. 10
Total Missouri	27	20	20	8	2, 460, 749	2, 460, 749		713	259	972	186	61. 8	180, 478	13. 63
Montana:														
Montana and Texas lignite	4	2	2	1	87, 227	87, 227		34	1	35	113	[2] 11. 5	3, 942	22. 13
Rosebud	1		2	1	1, 225, 468	1, 225, 468		41	12	53	303	99. 9	16, 059	76. 31
Total Montana [3]	5	2	4	2	1, 312, 695	1, 312, 695		75	13	88	227	[4] 34. 6	20, 001	65. 63
North Dakota: Lignite	55	9	7	10	1, 366, 921	1, 371, 239	3	408	117	528	212	61. 7	111, 910	12. 25
Ohio:														
Carroll, Coshocton, Hocking, Holmes, Muskingum, Vinton, and Wayne	7	3	2	7	248, 077	257, 681	15	133	34	182	173	15. 3	31, 571	8. 16
Columbiana	7	3		9	248, 478	248, 478		116	37	153	195	58. 5	29, 900	8. 31
Harrison	4	13		1	639, 173	639, 173		204	81	285	192	23. 5	54, 650	11. 70
Jackson	6	5		6	122, 381	129, 786	13	78	20	111	142	44. 0	15, 789	8. 22
Jefferson	3	7	2	1	862, 334	862, 334		180	67	247	266	20. 5	65, 596	13. 15
Perry	3	1		2	124, 697	124, 697		56	16	72	205	13. 6	14, 740	8. 46
Stark	7	6		9	183, 884	190, 604	7	80	14	101	249	28. 1	25, 166	7. 57
Tuscarawas	8	3		6	29, 092	34, 943	4	49	6	59	106	2. 3	6, 250	5. 59
Total Ohio	45	41	4	41	2, 458, 116	2, 487, 696	39	896	275	1, 210	201	[1] 20. 4	243, 662	10. 21

See footnotes at end of table.

TABLE 14.—*Stripping operations of all types in bituminous-coal fields in 1936, by States and counties*—Continued

State and county	Number of strip pits	Number of power shovels			Coal produced (net tons)		Number of employees				Average number of days mines operated	Percent of county or State total mined by stripping	Man-days of labor	Average tons per man per day
		Steam	Electric	All others	Mined by stripping	Total at same mines	Underground	Surface		Total				
								In strip pits	All others					
Oklahoma: Haskell, Rogers, and Wagoner	5	6	2	--------	343,598	343,598	--------	153	25	178	162	22.3	28,921	11.88
Pennsylvania: Beaver, Butler, Cambria, Clarion, Clearfield, Clinton, Elk, Fayette, Lycoming, McKean, Tioga, Washington, and Westmoreland	18	20	--------	10	753,784	1,442,549	584	294	224	1,102	222	[1] 1.1	244,847	5.89
South Dakota: Lignite	4	--------	--------	4	33,517	33,517	--------	24	5	29	280	81.1	8,110	4.13
Wyoming: Campbell, Carbon, and Converse	4	--------	2	2	142,694	152,938	5	37	17	59	268	[1] 19.6	15,806	9.68
Other States [5]	6	6	1	1	110,911	474,934	342	113	88	543	166	[1] .9	90,329	5.26
Total United States	381	188	151	223	28,125,857	29,224,734	975	8,043	3,532	12,550	185	6.4	2,319,855	12.60

[1] Percent of county totals, not State.
[2] Percent of total Texas and Montana lignite.
[3] Includes Texas lignite.
[4] Percent of total Texas and Montana lignite and Montana bituminous.
[5] Arkansas, Colorado, Kentucky, and West Virginia.

TABLE 15.—*Summary of operations of power strip pits proper in the bituminous-coal fields in 1936, by States*

State	Number of strip pits	Number of power shovels: Steam	Number of power shovels: Electric	Number of power shovels: All others	Amount mined by stripping[1] (net tons)	Number of men employed[2]	Average number of days mines operated[2]	Average tons per man per day[2]
Power strip pits proper:								
Alabama	4	9		2	46,406	168	69	4.03
Illinois	49	8	62	47	9,091,844	3,030	191	15.72
Indiana	62	39	34	59	7,665,333	3,143	180	13.53
Iowa	18	1	2	20	251,744	232	137	7.92
Kansas	38	26	13	17	2,001,246	1,015	161	12.28
Missouri	25	20	20	8	2,457,849	961	187	13.68
Montana (bituminous)	1		2	1	1,225,468	53	303	76.31
Montana, North Dakota, South Dakota, and Texas (lignite)[3]	15	11	9	15	1,423,486	447	237	13.51
Ohio	37	36	4	38	2,415,940	1,123	200	10.74
Oklahoma	5	6	2		343,598	178	162	11.88
Pennsylvania	11	13		10	338,067	233	188	7.72
Other States[4]	6	4	3	2	217,720	156	164	8.49
Total	271	173	151	219	27,478,701	10,739	184	13.91
Horse stripping operations	96				163,438	424	106	3.65
Mines combining stripping and underground methods in same operations[5]	14	15		4	483,718	1,387	216	5.28
Grand total	381	188	151	223	28,125,857	12,550	185	12.60

[1] Exclusive of coal produced by underground mining in the same operation.
[2] Items in these columns include underground mining conducted in the same operation.
[3] Includes one mine in North Dakota which has both underground and strip mining in the same operation.
[4] Arkansas, Colorado, Kentucky, and Wyoming.
[5] Includes operations in Alabama, Kentucky, Ohio, Pennsylvania, and Wyoming, in which the output was obtained by both methods. In addition to the 483,718 tons produced by stripping this group of 14 mines obtained 1,094,559 tons by underground methods, its total production by both methods being 1,578,277 tons.

TABLE 16.—*Stripping operations of all types in bituminous-coal fields in 1937, by States and counties*

State and county	Number of strip pits	Coal produced (net tons): Mined by stripping	Coal produced (net tons): Total at same mines[1]	Number of men employed[1]	Average number of days mines operated[1]	Average tons per man per day[1]
Alabama: Blount and Walker	4	36,268	38,041	199	69	2.75
Arkansas: Franklin and Sebastian	5	28,472	28,472	39	106	6.88
Illinois:						
Adams, Brown, Edgar, Henry, Jackson, Knox, Randolph, Vermilion, and Will	12	3,827,854	3,827,854	1,210	226	13.99
Fulton	9	2,671,871	2,671,871	700	187	20.44
Grundy	4	101,488	101,488	105	72	13.47
LaSalle	11	223,439	223,439	190	130	9.03
Perry	4	2,787,746	2,787,746	694	195	20.63
St. Clair	6	449,233	449,233	124	160	22.61
Saline	4	783,268	783,268	196	187	21.37
Williamson	8	603,833	603,833	192	156	20.21
Total Illinois	58	11,448,732	11,448,732	3,411	193	17.40
Indiana:						
Clay	25	1,095,698	1,095,698	647	170	9.95
Fountain	4	31,795	31,795	36	145	6.11
Greene	15	1,457,367	1,457,367	648	154	14.61
Owen	6	159,835	159,835	99	155	10.45
Pike	9	2,953,423	2,953,423	879	207	16.25
Spencer and Vermillion	3	42,595	42,595	69	58	10.70
Sullivan	6	461,569	461,569	237	116	16.79
Vigo	6	1,002,046	1,002,046	248	229	17.67
Warrick	5	1,076,674	1,076,674	324	224	14.84
Total Indiana	79	8,281,002	8,281,002	3,187	180	14.46

See footnotes at end of table.

TABLE 16.—*Stripping operations of all types in bituminous-coal fields in 1937, by States and counties*—Continued

State and county	Number of strip pits	Coal produced (net tons): Mined by stripping	Coal produced (net tons): Total at same mines [1]	Number of men employed [1]	Average number of days mines operated [1]	Average tons per man per day [1]
Iowa:						
Davis, Greene, Keokuk, Monroe, Wapello, Warren, and Webster	11	98,881	98,881	134	113	6.56
Mahaska	8	171,308	171,308	111	174	8.85
Marion	14	142,954	142,954	139	151	6.81
Van Buren	3	5,808	5,808	12	142	3.40
Total Iowa	36	418,951	418,951	396	144	7.33
Kansas:						
Bourbon	6	63,289	63,289	99	104	6.12
Cherokee	4	263,573	263,573	121	142	15.29
Crawford	24	1,598,956	1,598,956	752	167	12.71
Labette	4	16,443	16,443	29	156	3.63
Linn and Neosho	5	17,249	17,249	26	167	3.98
Osage	6	7,141	7,141	30	100	2.37
Total Kansas	49	1,966,651	1,966,651	1,057	156	11.90
Missouri:						
Barton	7	504,962	504,962	185	180	15.16
Bates	4	670,397	670,397	282	167	14.23
Boone, Dade, Jasper, Johnson, Macon, Ralls, Randolph, and Warren	11	712,021	712,021	306	184	12.67
Callaway	3	78,627	78,627	53	269	5.51
Henry	7	599,981	599,981	311	195	9.87
Vernon	6	88,179	88,179	88	166	6.05
Total, Missouri	38	2,654,167	2,654,167	1,225	185	11.73
Montana: (Montana and Texas lignite)	4	88,574	88,574	34	115	22.67
Rosebud	1	1,247,337	1,247,337	63	258	76.70
Total Montana [2]	5	1,335,911	1,335,911	97	208	66.24
North Dakota: (Lignite)	72	1,347,355	1,348,615	582	177	13.13
Ohio:						
Carroll	3	26,060	26,060	23	138	8.23
Columbiana	12	218,822	218,822	118	185	10.01
Coshocton, Hocking, Holmes, Lawrence, Mahoning, Perry, Vinton, and Wayne	12	285,181	299,706	191	204	7.68
Harrison	4	521,371	521,371	232	174	12.88
Jackson	6	75,456	81,026	93	134	6.50
Jefferson	8	1,003,327	1,003,327	296	241	14.07
Muskingum	3	71,732	71,732	117	75	8.20
Stark	8	196,338	203,230	106	255	7.53
Tuscarawas	12	70,337	77,355	71	181	6.03
Total Ohio	68	2,468,624	2,502,629	1,247	190	10.57
Oklahoma:						
Haskell, Muskogee, and Wagoner	6	432,842	432,842	256	133	12.75
Rogers	3	33,093	33,093	16	206	10.06
Total Oklahoma	9	465,935	465,935	272	137	12.51
Pennsylvania: Allegheny, Beaver Butler, Cambria, Clarion, Clearfield, Fayette, Lycoming, Tioga, Washington, and Westmoreland	12	853,944	1,111,296	588	232	8.15
South Dakota (Lignite)	4	42,094	42,094	27	213	7.33
Wyoming: Campbell, Carbon, and Converse	5	167,799	183,978	74	260	9.55
Other States [3]	5	234,948	248,083	192	117	11.02
Total United States	449	31,750,853	32,074,557	12,593	181	14.08

[1] Items in these columns include underground mining conducted in the same operation.
[2] Includes Texas lignite.
[3] Colorado, Kentucky, and West Virginia.

UNDERCUTTING MACHINES IN 1936

TABLE 17.—*Number of coal-cutting machines in bituminous-coal mines, average output per machine, and percentage of total product of underground mines cut by machines in 1936, by States* [1]

State	Number of coal-cutting machines in use			Average output per machine (net tons)	Percent of total product of underground mines cut by machines
	"Permissible"	All others [2]	Total		
Alabama	69	276	345	25,688	72.8
Arkansas	54	95	149	8,538	81.2
Colorado	105	286	391	11,914	68.6
Illinois	345	940	1,285	28,760	88.4
Indiana	92	223	315	29,071	90.3
Iowa	64	49	113	11,649	35.7
Kansas	17	10	27	9,628	28.3
Kentucky	382	1,034	1,416	31,420	93.7
Maryland	16	22	38	15,960	35.6
Michigan	9	46	55	11,192	98.3
Missouri	48	44	92	9,703	58.6
Montana and Texas	17	39	56	29,181	64.9
New Mexico	29	16	45	9,172	25.8
North Dakota	20	5	25	23,070	68.0
Ohio	297	655	952	21,512	94.6
Oklahoma	64	46	110	8,530	78.4
Pennsylvania	2,247	1,125	3,372	24,868	76.9
Tennessee	27	85	112	31,940	70.0
Utah	53	67	120	23,635	87.4
Virginia	59	194	253	41,564	90.2
Washington	30	6	36	18,074	35.9
West Virginia	991	1,412	2,403	45,127	92.0
Wyoming	45	217	262	20,322	94.5
Other States		2	2	1,583	20.6
Total United States	5,080	6,894	11,974	29,091	84.8

[1] Similar data for 1937 are not available.
[2] Probably includes some "permissible" machines not so specified by the operators.

LOADING MACHINES AND CONVEYORS IN 1936, AND SALES IN 1937 AND 1938

Mechanical loading in 1936 and 1937.—The data for mechanical loading refer to all devices designed to reduce the labor of hand shoveling into mine cars. Data for 1936 are based on complete returns courteously furnished by coal operators. Figures for 1937 are preliminary and are based on various sources, as indicated in the footnotes to table 18.

TABLE 18.—*Bituminous coal mechanically loaded, 1935–37, by States, in net tons*

State	1935 [1]	1936	1937 (preliminary)
Alabama	1,303,653	1,741,452	[2] 2,100,000
Arkansas	292,064	522,411	[2] 550,000
Colorado	197,319	557,548	[3] 1,018,039
Illinois	20,513,082	26,110,068	[4] 28,344,362
Indiana	5,767,696	7,146,090	[5] 7,426,306
Iowa	----	(6)	(6)
Kentucky	533,250	658,747	[2] 1,300,000
Maryland	(6)	(6)	(6)
Missouri	(6)	----	----
Montana	1,291,373	1,464,121	[2] 1,431,000
New Mexico	(6)	(6)	(6)
North Dakota	(6)	(6)	(6)
Ohio	1,488,303	2,049,075	[7] 3,204,102
Oklahoma	(6)	(6)	(6)
Pennsylvania	6,469,485	9,033,855	[8] 11,951,639
Tennessee	233,579	290,220	[2] 450,000
Utah	898,118	1,358,543	[2] 1,835,000
Virginia	651,807	779,232	[2] 1,500,000
Washington	429,617	608,488	[9] 838,000
West Virginia	2,059,322	8,712,935	[10] 15,490,863
Wyoming	4,530,032	5,189,263	[11] 5,300,000
Undistributed	518,524	754,824	760,689
Total United States	47,177,224	66,976,872	83,500,000

[1] Bureau of Mines Minerals Yearbook, 1937, pp. 832, 887.
[2] Estimated on the basis of sales of new equipment in 1937.
[3] Thomas Allen, State inspector of coal mines, Colorado.
[4] James McSherry, director, Department of Mines and Minerals, Illinois.
[5] Jonas Waffle, managing director, Coal Trade Association of Indiana.
[6] Included in "Undistributed." Data for 1937 are based largely on telegraphic reports from operators.
[7] Milan W. Hranilovich, Division of Labor Statistics, Department of Industrial Relations, Ohio.
[8] M. J. Hartneady, Secretary of Mines, Pennsylvania.
[9] Telegraphic reports from mine operators.
[10] N. P. Rhinehart, chief, Department of Mines, West Virginia.
[11] Hugh McLeod, State mine inspector, Wyoming.

TABLE 19.—*Bituminous coal mechanically loaded underground in 1936, by types of machines*

	Net tons	Percent
Loaded by machine:		
Mobile loading machines	40,969,625	90.1
Scraper loaders	1,272,466	2.8
Conveyors equipped with duckbills and other self-loading devices	3,240,411	7.1
Total loaded by machine	45,482,502	100.0
Handled by conveyors:		
Conveyors equipped with duckbills and other self-loading devices	3,240,411	13.1
Pit-car loaders	10,538,331	42.6
Hand-loaded conveyors	10,956,039	44.3
Total handled by conveyors	24,734,781	100.0
Recapitulation, less duplications:		
Mobile loading machines	40,969,625	61.2
Scraper loaders	1,272,466	1.9
Conveyors equipped with duckbills and other self-loading devices	3,240,411	4.8
Pit-car loaders	10,538,331	15.7
Hand-loaded conveyors	10,956,039	16.4
Grand total loaded mechanically	66,976,872	100.0

TABLE 20.—*Comparative change in tonnage of bituminous coal loaded by principal types of machines, 1935–36*

	1935 (net tons)	1936 (net tons)	Increase or decrease in 1936	
			Net tons	Percent
Mobile loading machines	24, 675, 248	40, 969, 625	+16, 294, 377	+66. 0
Scraper loaders	1, 118, 201	1, 272, 466	+154, 265	+13. 8
Duckbills and other self-loading conveyors	2, 594, 564	3, 240, 411	+645, 847	+24. 9
Total loaded by machines	28, 388, 013	45, 482, 502	+17, 094, 489	+60. 2
Pit-car loaders	11, 098, 466	10, 538, 331	−560, 135	−5. 0
Other hand-loaded conveyors	7, 690, 745	10, 956, 039	+3, 265, 294	+42. 5
Grand total	47, 177, 224	66, 976, 872	+19, 799, 648	+42. 0

TABLE 21.—*Percent of State output of deep-mined bituminous coal mechanically loaded in each State, 1933–36, by classes of equipment*

State	Percent of underground production loaded by machines in each State [1]				Percent of underground production handled by conveyors in each State [2]				Total			
	1933	1934	1935	1936	1933	1934	1935	1936	1933	1934	1935	1936
Alabama	2. 0	1. 6	3. 4	4. 4	14. 0	10. 2	12. 0	9. 9	16. 0	11. 8	15. 4	14. 3
Arkansas	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	17. 0	25. 1	26. 6	33. 3
Colorado	. 7	(3)	1. 6	5. 1	. 7	(3)	1. 7	3. 1	1. 4	1. 3	3. 3	8. 2
Illinois	32. 6	33. 1	34. 5	44. 5	21. 3	19. 5	20. 8	17. 9	53. 9	52. 6	55. 3	62. 4
Indiana	36. 2	47. 7	54. 0	63. 1	12. 4	13. 7	8. 5	7. 3	48. 6	61. 4	62. 5	70. 5
Iowa	------	------	------	------	(3)	------	------	(3)	(3)	------	------	(3)
Kentucky	(3)	(3)	(3)	. 2	(3)	(3)	(3)	1. 2	2. 2	1. 9	1. 3	1. 4
Maryland	------	------	------	------	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Missouri	------	------	------	------	(3)	(3)	(3)	------	(3)	(3)	(3)	------
Montana	66. 8	60. 4	59. 5	70. 4	12. 7	18. 7	20. 6	12. 8	79. 5	79. 1	80. 1	83. 2
New Mexico	(3)	(3)	(3)	(3)	------	------	------	------	(3)	(3)	(3)	(3)
North Dakota	------	(3)	(3)	(3)	------	------	------	------	------	(3)	(3)	(3)
Ohio	(3)	5. 8	7. 8	9. 2	(3)	------	------	. 2	5. 5	5. 8	7. 8	9. 5
Oklahoma	------	(3)	(3)	(3)	------	------	------	------	------	(3)	(3)	(3)
Pennsylvania	1. 8	1. 5	1. 5	3. 2	6. 7	5. 8	5. 6	5. 1	8. 5	7. 3	7. 1	8. 3
Tennessee	(3)	(3)	2. 1	1. 8	(3)	(3)	3. 5	3. 9	(3)	(3)	5. 6	5. 7
Utah	(3)	23. 5	28. 4	38. 5	(3)	1. 4	2. 1	3. 4	20. 6	24. 9	30. 5	41. 8
Virginia	------	------	(3)	1. 4	4. 5	4. 1	(3)	5. 3	4. 5	4. 1	6. 7	6. 7
Washington	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	19. 4	24. 6	27. 6	33. 6
West Virginia	. 4	. 7	1. 2	5. 4	. 4	. 7	. 9	2. 0	. 8	1. 4	2. 1	7. 4
Wyoming	60. 3	69. 6	74. 8	76. 5	15. 5	14. 5	15. 0	15. 5	75. 8	84. 1	89. 8	92. 0
Undistributed	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)	(4)
United States total	6. 5	7. 0	8. 1	11. 1	5. 5	5. 2	5. 4	5. 2	12. 0	12. 2	13. 5	16. 3

[1] Includes mobile loaders, scrapers, and duckbills.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Concealed to avoid disclosing results of individual operations.
[4] Not calculated because figures are not comparable from year to year.

TABLE 22.—*Mechanical loading underground in bituminous-coal mines in 1936, by States*

[The table includes all soft-coal mines that produced any part of their tonnage with the aid of mechanical loading devices in 1936. The mines have been grouped into three classes. The first includes those mines in which all of the tonnage mechanically loaded was obtained with machines that substantially eliminate hand shoveling; that is, mobile loaders, scrapers, and duckbill-equipped conveyors. It should be noted, however, that some of these mines make use of conveyors in conjunction with mobile loaders to perform the initial phase of transportation. The second class includes those mines in which all the tonnage mechanically loaded was obtained with hand-loaded conveyors or pit-car loaders. The third class includes mines that load with both types of machines]

State	Number of mines				Number of machines					Production mechanically loaded (net tons)			Total production of mechanized mines (net tons)			
	Using loading machines only [1]	Using conveyors only [2]	Using both loading machines and conveyors	Total	Mobile loading machines	Scrapers	Conveyors equipped with duckbills and other self-loading devices	Pit-car loaders	Installations of hand-loaded conveyors [3]	Loaded by machines [1]	Handled by conveyors [2]	Total	Mines using loading machines only [1]	Mines using conveyors only [2]	Mines using both loading machines and conveyors	Total
Alabama	8	13	6	27	10	27	5	(4)	15	541,005	1,200,447	1,741,452	2,292,173	2,079,844	849,168	5,221,185
Arkansas	2	15		17		(4)			15	(4)	(4)	522,411	(4)	(4)		558,485
Colorado	9	7	1	17	(4)		25		8	344,598	212,950	557,548	(4)	1,018,727	(4)	1,929,977
Illinois	36	14	16	66	431			1,151	1	18,607,302	7,502,766	26,110,068	14,125,730	6,114,091	10,129,258	30,369,079
Indiana	19	8	5	32	146			74	2	6,402,957	743,133	7,146,090	5,870,010	582,887	1,012,779	7,465,676
Iowa		2		2					2		(4)	(4)		(4)		(4)
Kentucky	3	10	3	16	(4)	(4)	(4)	(4)	10	85,012	573,735	658,747	(4)	1,644,211	(4)	5,094,373
Maryland		3		3					3		(4)	(4)		(4)		(4)
Montana	3		3	6	31		(4)	32		1,239,069	225,052	1,464,121	817,216		746,297	1,563,513
New Mexico	2			2	(4)	(4)				(4)		(4)	(4)			(4)
North Dakota	2			2	(4)					(4)		(4)	(4)			(4)
Ohio	14	6		20	47		(4)		6	2,002,526	46,549	2,049,075	5,613,823	872,307		6,486,130
Oklahoma	1			1		(4)				(4)		(4)	(4)			(4)
Pennsylvania	18	41	11	70	92	31	(4)	(4)	43	3,455,323	5,578,532	9,033,855	7,263,015	10,966,131	7,077,456	25,306,602
Tennessee	1	1	2	4	(4)	(4)	(4)		3	91,975	198,245	290,220	(4)	(4)	(4)	824,700
Utah	7	3	1	11	43			(4)	4	1,248,483	110,060	1,358,543	(4)	(4)	(4)	2,180,400
Virginia	5	6		11	9				6	159,884	619,348	779,232	298,540	1,793,592		2,092,132
Washington	1	4		5			(4)		4	(4)	(4)	608,488	(4)	(4)		651,053
West Virginia	43	53	4	100	126	(4)			57	6,334,220	2,378,715	8,712,935	16,762,116	11,146,894	1,257,291	29,166,301
Wyoming	10	6	8	24	24	(4)	175	66	6	4,313,885	875,378	5,189,263	2,174,568	678,710	2,519,219	5,372,497
Undistributed					21	48	29	528		656,263	1,229,460	754,824	3,808,821	2,589,848	3,864,035	1,686,654
Total:																
1936	184	192	60	436	980	106	234	1,851	185	45,482,502	21,494,370	66,976,872	59,026,012	39,487,242	27,455,503	125,968,757
1935	113	158	46	317	657	78	180	2,098	135	28,388,013	18,789,211	47,177,224	33,040,992	34,933,922	18,545,116	86,520,030
Percent change in 1936	+62.8	+21.5	+30.4	+37.5	+49.2	+35.9	+30.0	−11.8	+37.0	+60.2	+14.4	+42.0	+78.6	+13.0	+48.0	+45.6

[1] Includes mobile loading machines, scrapers, and conveyors equipped with duckbills and other self-loading heads. Some mines in this class also use conveyors in conjunction with mobile loaders to perform the initial phase of transportation.

[2] Includes hand-loaded conveyors and pit-car loaders.

[3] Number of mines in which hand-loaded conveyors (other than pit-car loaders) were used.

[4] Included under "Undistributed" to avoid disclosing individual operations.

TABLE 23.—*Comparative changes in mechanical loading by principal types of machines, 1935–36, by States, in net tons*

State	1935			1936			Increase or decrease in 1936						Percent handled by each class			
							Quantity			Percent			1935		1936	
	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines [1]	Handled by conveyors [2]	Total	Loaded by machines	Handled by conveyors	Total	Loaded by machines	Handled by conveyors	Loaded by machines	Handled by conveyors
Alabama	286, 483	1, 017, 170	1, 303, 653	541, 005	1, 200, 447	1, 741, 452	+254, 522	+183, 277	+437, 799	+88. 8	+18. 0	+33. 6	[3] 22. 0	78. 0	[3] 31. 1	68. 9
Arkansas	(4)	(4)	292, 064	(4)	(4)	522, 411	(4)	(4)	+230, 347	(4)	(4)	+78. 9	(4)	(4)	(4)	(4)
Colorado	97, 269	100, 050	197, 319	344, 598	212, 950	557, 548	+247, 329	+112, 900	+360, 229	+254. 3	+112. 8	+182. 6	[5] 49. 3	[6] 50. 7	61. 8	38. 2
Illinois	12, 809, 739	7, 703, 343	20, 513, 082	18, 607, 302	7, 502, 766	26, 110, 068	+5, 797, 563	−200, 577	+5, 596, 986	+45. 3	−2. 6	+27. 3	[7] 62. 4	[8] 37. 6	[7] 71. 3	[8] 28. 7
Indiana	4, 986, 408	781, 288	5, 767, 696	6, 402, 957	743, 133	7, 146, 090	+1, 416, 549	−38, 155	+1, 378, 394	+28. 4	−4. 9	+23. 9	[7] 86. 5	[9] 13. 5	[7] 89. 6	[9] 10. 4
Iowa	----------	----------	----------	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	----------	----------	100. 0
Kentucky	(4)	(4)	533, 250	85, 012	573, 735	658, 747	(4)	(4)	+125, 497	(4)	(4)	+23. 5	(4)	(4)	[5] 12. 9	87. 1
Maryland	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	100. 0	(4)	100. 0
Missouri	----------	(4)	(4)	----------	----------	----------	----------	(4)	(4)	----------	(4)	(4)	----------	100. 0	----------	----------
Montana	959, 596	331, 777	1, 291, 373	1, 239, 069	225, 052	1, 464, 121	+279, 473	−106, 725	+172, 748	+29. 1	−32. 2	+13. 4	[5] 74. 3	[10] 25. 7	[5] 84. 6	[10] 15. 4
New Mexico	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	100. 0	----------	100. 0	----------
North Dakota	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	[7] 100. 0	----------	[7] 100. 0	----------
Ohio	1, 488, 303	----------	1, 488, 303	2, 002, 526	46, 549	2, 049, 075	+514, 223	+46, 549	+560, 772	+34. 6	+100. 0	+37. 7	[7] 100. 0	----------	[11] 97. 7	[6] 2. 3
Oklahoma	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	(4)	----------	(4)	100. 0	----------	100. 0	----------
Pennsylvania	1, 387, 241	5, 082, 244	6, 469, 485	3, 455, 323	5, 578, 532	9, 033, 855	+2, 068, 082	+496, 288	+2, 564, 370	+149. 1	+9. 8	+39. 6	[5] 21. 4	78. 6	[5] 38. 2	61. 8
Tennessee	87, 898	145, 681	233, 579	91, 975	198, 245	290, 220	+4, 077	+52, 564	+56, 641	+4. 6	+36. 1	+24. 2	37. 6	[6] 62. 4	31. 7	[6] 68. 3
Utah	836, 574	61, 544	898, 118	1, 248, 483	110, 060	1, 358, 543	+411, 909	+48, 516	+460, 425	+49. 2	+78. 8	+51. 3	[7] 93. 1	6. 9	[7] 91. 9	8. 1
Virginia	(4)	(4)	651, 807	159, 884	619, 348	779, 232	(4)	(4)	+127, 425	(4)	(4)	+19. 5	(4)	(4)	[7] 20. 5	[6] 79. 5
Washington	(4)	(4)	429, 617	(4)	(4)	608, 488	(4)	(4)	+178, 871	(4)	(4)	+41. 6	(4)	(4)	(4)	(4)
West Virginia	1, 197, 119	862, 203	2, 059, 322	6, 334, 220	2, 378, 715	8, 712, 935	+5, 137, 101	+1, 516, 512	+6, 653, 613	+429. 1	+175. 9	+323. 1	[5] 58. 1	[6] 41. 9	[11] 72. 7	[6] 27. 3
Wyoming	3, 774, 960	755, 072	4, 530, 032	4, 313, 885	875, 378	5, 189, 263	+538, 925	+120, 306	+659, 231	+14. 3	+15. 9	+14. 6	83. 3	16. 7	83. 1	16. 9
Undistributed	476, 423	1, 948, 839	518, 524	656, 263	1, 229, 460	754, 824	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)	(12)
	28, 388, 013	18, 789, 211	47, 177, 224	45, 482, 502	21, 494, 370	66, 976, 872	+17, 094, 489	+2, 705, 159	+19, 799, 648	+60. 2	+14. 4	+42. 0	60. 2	39. 8	67. 9	32. 1

[1] Includes mobile loaders, scrapers, duckbills, and other self-loading conveyors.
[2] Includes hand-loaded conveyors and pit-car loaders.
[3] Principally by scrapers.
[4] Included under "Undistributed" to avoid disclosing individual operations.
[5] Principally by mobile loaders.
[6] Entirely by conveyors.
[7] Entirely by mobile loaders.
[8] Practically all by pit-car loaders.
[9] Principally by pit-car loaders.
[10] Entirely by pit-car loaders.
[11] Practically all by mobile loaders.
[12] Included in total; tons loaded and percentage by types not given because State groups are not comparable in 1935 and 1936.

Sales of mechanical loading equipment in 1937 and 1938.—The trend of mechanization since 1936 is indicated by manufacturers' sales of equipment. Figure 7 shows the relative amount of coal mechanically loaded in 1936 in each producing State, together with the approximate capacity of new equipment installed in 1937 and 1938. The chart therefore affords a rough measure of the mechanical loading capacity available at the beginning of 1939, by States. Tables 24 and 25 give the details of sales.

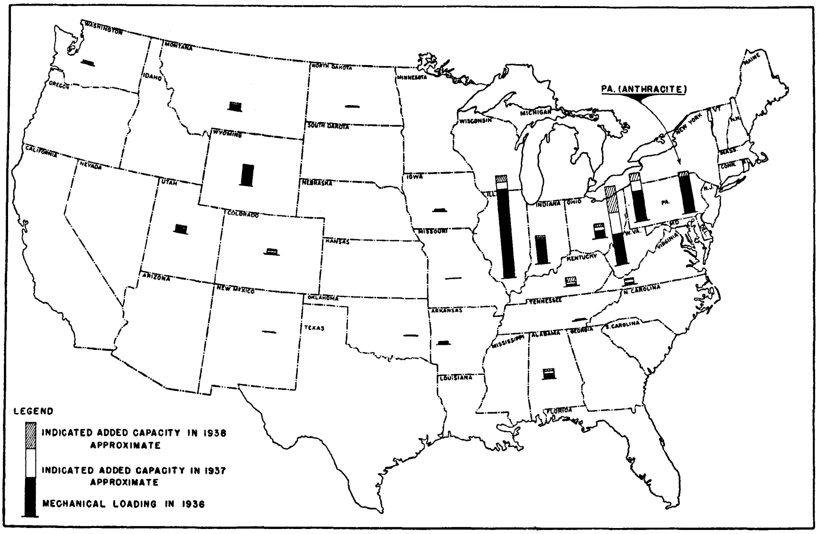

FIGURE 7.—Bituminous coal mechanically loaded in 1936 and approximate capacity of new equipment shipped in 1937 and 1938.

TABLE 24.—*Sales of mechanized loading equipment in 1937 and 1938 compared with total number of machines in active use in preceding years*

	Number of machines in active use, as reported by mine operators								Number of machines sold as reported by 29 manufacturers	
	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Mobile loading machines	488	545	583	548	523	534	657	980	292	241
Scrapers	126	150	146	128	93	119	78	106	13	6
Pit-car loaders	2,521	2,876	3,428	3,112	2,453	2,288	2,098	1,851	32	139
Conveyors equipped with duckbills and other self-loading heads	99	140	165	159	132	157	179	234	[2] 835	749
Hand-loaded conveyors—number of units	(1)	(1)	(1)	(1)	525	574	670	936		

[1] Number of units not reported in these years.
[2] Reported as face conveyors (hand-loaded), "shaker drives," and "duckbills." The figures of numbers sold in 1937 and 1938 are not exactly comparable with the number in use in 1936, because of uncertainties in defining what constitutes a conveyor.

TABLE 25.—*Comparison of mobile loaders, scrapers, and conveyors in actual use in bituminous-coal mines in 1936 with sales reported in 1937 and 1938, by regions*

	Mobile loaders			Scrapers			Conveyors [1]		
	In use, 1936	Sales		In use, 1936	Sales		In use, 1936	Sales	
		1937	1938		1937	1938		1937	1938
Northern Appalachian States:									
Pennsylvania	92	23	47	31	--------	--------	366	105	52
Maryland	--------	--------	--------	--------	--------	--------			
Ohio	47	28	15	--------	--------	--------	18	37	23
Southern Appalachian States:									
Alabama	10	7	[2] 39	27	5	2	64	64	64
Kentucky	5	18		11	--------	--------	35	106	98
Tennessee		1			1	--------	21	38	20
West Virginia	126	73	80		5	3	196	275	332
Virginia	9	8	9	--------	1	--------	70	16	5
Middle Western States:									
Illinois	431	81	[3] 38	--------	--------	--------	7	19	20
Indiana	146	31		--------	--------	--------			
Trans-Mississippi States	[4] 114	[5] 22	[6] 13	[7] 37	[8] 1	1	[9] 393	[10] 175	[11] 135
	980	292	241	106	13	6	1,170	835	749

[1] Includes hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads. The figures of number in use in 1936 are not exactly comparable with the number sold in 1937 and 1938 because of uncertainties in defining what constitutes a conveyor. The comparison, however, will serve to indicate which regions have made the largest proportionate increases.
[2] Mostly in Kentucky.
[3] Mostly in Illinois.
[4] Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming.
[5] Arkansas, Montana, Utah, and Wyoming.
[6] Colorado, Montana, Oklahoma, Utah, and Wyoming.
[7] Arkansas, New Mexico, Oklahoma, and Wyoming.
[8] Wyoming.
[9] Arkansas, Colorado, Iowa, Montana, Utah, Washington, and Wyoming.
[10] Arkansas, Colorado, Iowa, Utah, and Wyoming.
[11] Arkansas, Colorado, Iowa, Oklahoma, Utah, and Wyoming.

POWER DRILLING IN UNDERGROUND MINES IN 1936

In 1936, a total of 111,950,000 tons (27.2 percent) of the deep-mined bituminous-coal output was produced from working places in which the shot holes were drilled by mechanical power drills as contrasted with hand drills. Power drills are in use or on trial in nearly every important coal-producing county. In some counties the production by power drills is substantial; in others it is insignificant. The conditions under which this kind of labor-saving device is used differ widely, not only geographically but also as to thickness of beds, pitch of seams, and hardness of the coal itself. The widespread acceptance of this mechanical tool under varying conditions indicates an extensive market for drilling machinery, since three-fourths of the Nation's production of bituminous coal is still hand-drilled. The application of power drills is another step toward substitution of mechanical devices for hand labor.

The amount of bituminous coal produced by the use of electric drills amounted to 100,050,000 tons and by compressed-air drills 11,900,000, a total of 111,950,000 tons. More than 88 percent of the total produced by compressed-air drills came from Western Pennsylvania.

For details by States showing tons produced by the two types of drills, percentage power-drilled compared with machine cutting and mechanical loading, and total production of mines using one or more drills in coal or rock or both, see "A Reconnaissance of Power Drilling in Underground Bituminous-Coal Mines in 1936," by J. J. Gallagher and L. N. Plein in Mining Congress Journal, January 1939, pages 26–28; also National Bituminous Coal Commission Weekly Coal Report 1118, December 17, 1938.

MECHANICAL CLEANING IN 1936

Data on mechanical cleaning of coal in 1936 are given in tables 26 to 31. Although figures for 1937 and 1938 are not available reports from manufacturers of mechanical cleaning equipment indicate that a large number of new installations were made in these years.

TABLE 26.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, 1935–36, in net tons of clean coal*

	1935	1936	Increase in 1936	
			Net tons	Percent
By wet methods:				
At the mines	31,006,643	42,795,529	+11,788,886	+38.0
At central washeries operated by consumers	5,849,845	7,708,499	+1,858,654	+31.8
Total wet	36,856,488	50,504,028	+13,647,540	+37.0
By pneumatic methods	8,504,533	10,590,948	+2,086,415	+24.5
Grand total	45,361,021	61,094,976	+15,733,955	+34.7

TABLE 27.—*Bituminous coal cleaned, 1935–36, by classes of equipment in actual operation*

[Coal cleaned and plants operated by consumers at central washeries in Colorado and Pennsylvania are included.]

Type of equipment	Plants in operation		Net tons of clean coal		Increase in 1936		Percent cleaned by each type	
	1935	1936	1935	1936	Net tons	Percent	1935	1936
Wet methods:								
Jigs	138	154	15,735,039	23,417,266	+7,682,227	+48.8	34.7	38.3
Concentrating tables [1]	9	8	1,117,789	1,843,167	+725,378	+64.9	2.5	3.0
Jigs in combination with concentrating tables [1]	15	16	1,549,422	2,612,666	+1,063,244	+68.6	3.4	4.3
Launders and upward-current classifiers	93	98	18,454,238	22,630,929	+4,176,691	+22.6	40.7	37.1
Total wet	255	276	36,856,488	50,504,028	+13,647,540	+37.0	81.3	82.7
Pneumatic methods	65	66	8,504,533	10,590,948	+2,086,415	+24.5	18.7	17.3
Grand total	[2] 320	[2] 342	45,361,021	61,094,976	+15,733,955	+34.7	100.0	100.0

[1] A more representative figure for the use of wet tables is indicated by combining the totals for concentrating tables with the total for jigs in combination with concentrating tables. This shows a net gain of 1,788,622 tons (67.1 percent) for 1936.
[2] Plants using both wet and pneumatic types—32 in 1935; 31 in 1936.

TABLE 28.—*Total production of all coal at mines with cleaning plants, 1935–36, in net tons*

[Does not include any estimate for mines that may ship to consumer-operated plants]

	1935	1936	Increase or decrease in 1936	
			Net tons	Percent
Wet methods:				
Jigs	34,892,156	48,975,308	+14,083,152	+40.4
Concentrating tables	1,490,635	1,194,635	−296,000	−19.9
Jigs in combination with concentrating tables	1,771,351	2,791,533	+1,020,182	+57.6
Launders and upward-current classifiers	37,768,410	47,943,815	+10,175,405	+26.9
Total wet	75,922,552	100,905,291	+24,982,739	+32.9
Pneumatic methods	24,030,553	29,974,961	+5,944,408	+24.7
Grand total	99,953,105	130,880,252	+30,927,147	+30.9
Less duplication [1]	12,786,859	15,478,035	+2,691,176	+21.0
Net Total	87,166,246	115,402,217	+28,235,971	+32.4
United States production of bituminous coal	372,373,122	439,087,903	+66,714,781	+17.9
Percent produced at mines with cleaning plants	23.4	26.3		

[1] Mines using both wet and pneumatic methods.

TABLE 29.—*Bituminous coal mechanically cleaned by wet and pneumatic methods, 1935–36, by States*

[Coal cleaned at central washeries operated by consumers in Colorado and Pennsylvania is included]

State	Clean coal in net tons		Increase or decrease in 1936		Percent of State output mechanically cleaned	
	1935	1936	Net tons	Percent	1935	1936
Alabama	6,841,269	9,922,514	+3,081,245	+45.0	80.4	81.1
Colorado	492,874	713,678	+220,804	+44.8	8.3	10.5
Illinois	3,154,128	5,613,522	+2,459,394	+78.0	7.1	11.0
Indiana	1,283,555	2,198,067	+914,512	+71.2	8.2	12.3
Kentucky	351,568	514,647	+163,079	+46.4	.9	1.1
Missouri and Kansas	1,169,351	1,771,870	+602,519	+51.5	18.5	25.5
Ohio and Michigan	1,151,546	1,331,545	+179,999	+15.6	5.3	5.4
Pennsylvania	17,844,642	21,584,403	+3,739,761	+21.0	19.5	19.6
Tennessee	341,117	257,987	−83.130	−24.4	8.3	5.1
Virginia	389,548	473,992	+84,444	+21.7	4.0	4.1
Washington	614,771	1,203,783	+589,012	+95.8	39.4	66.4
West Virginia	11,613,813	15,360,671	+3,746,858	+32.2	11.7	13.0
Other States [1]	112,839	148,297	+35,458	+31.4		
	45,361,021	61,094,976	+15,733,955	+34.7	12.2	13.9

[1] Arkansas, Maryland, Montana, and New Mexico.

TABLE 30.—*Method of mining at mines served by cleaning plants, 1934–36*

Method of mining in use	Total production of mines with cleaning plants			Increase in 1936	
	1934	1935	1936	Net tons	Percent
Mined from strip pits	7,127,710	9,314,425	10,952,733	+1,638,308	+17.6
Mechanically loaded underground	10,128,745	15,065,777	23,461,832	+8,396,055	+55.7
Hand-loaded underground	59,052,707	62,786,044	80,987,652	+18,201,608	+29.0
	76,309,162	87,166,246	115,402,217	+28,235,971	+32.4

Relation between raw coal, clean coal, and refuse.—For every 100 tons of raw coal that passed into the cleaning systems about 90.5 tons came out as clean, merchantable product, and about 9.5 tons went to the refuse bank as worthless. Figures as to the amount of refuse resulting from cleaning operations seldom have been published, for several reasons: many mine operators cannot furnish exact figures, and the nature of the seam, the methods of mining, and the specific gravity at which the separation is made affect the percentage of refuse. With these factors in mind table 31 is offered as an indicator of the percentage of refuse resulting from mechanical cleaning in the various States.

TABLE 31.—*Relation between total production, raw coal, and refuse resulting from cleaning operations in 1936, by States, in net tons*

State	Total production of mines with cleaning plants	Result of cleaning operations			Percent of refuse to raw coal	Percent of clean coal to total mine production
		Raw coal	Clean coal	Refuse		
Alabama	11,135,961	11,119,454	9,922,514	1,196,940	10.8	89.1
Colorado	(1)	(1)	(1)	(1)	8.5	26.6
Illinois	17,191,716	6,675,210	5,613,522	1,061,688	15.9	32.7
Indiana	4,848,150	2,556,083	2,198,067	358,016	14.0	45.3
Kentucky	2,495,819	564,875	514,647	50,228	8.9	20.6
Missouri and Kansas	2,349,664	2,053,539	1,771,870	281,669	13.7	75.4
Ohio and Michigan	2,880,574	1,536,329	1,331,545	204,784	13.3	46.2
Pennsylvania	(1)	(1)	(1)	(1)	6.9	53.0
Tennessee	551,737	305,947	257,987	47,960	15.7	46.8
Virginia	1,853,615	551,211	473,992	77,219	14.0	25.6
Washington	1,502,214	1,429,682	1,203,783	225,899	15.8	80.1
West Virginia	42,034,038	16,408,308	15,360,671	1,047,637	6.4	36.5
Undistributed [2]	28,558,729	15,832,849	14,737,879	1,094,970	5.5	22.0
Total at mines only	115,402,217	59,033,487	53,386,477	5,647,010	9.6	46.3
Consumer plants		8,128,518	7,708,499	420,019	5.2	
Grand total		67,162,005	61,094,976	6,067,029	9.0	

[1] Included in "Undistributed."
[2] Tonnage figures include Arkansas, Colorado, Maryland, Montana, New Mexico, and Pennsylvania. Percentage figures represent results for Arkansas, Maryland, Montana, and New Mexico only.

SIZES PRODUCED

Complete statistics of the tonnage of each size of bituminous coal shipped in 1937 are given in the following publications of the Coal Commission, based on the distribution survey:

Key Table of Sizes and of Size Groups Proposed by District Boards in Western Districts; December 12, 1938.
Key Table of Sizes and of Size Groups Proposed by District Boards in Eastern Districts; January 4, 1939.
Key Table of Sizes and of Size Groups Proposed by District Boards in Middle Western Districts; January 4, 1939.

These tables give for the first time accurate data on the number and comparative importance of the manifold sizes in which bituminous coal is prepared for the market at present.

The analysis shows that in District 7 of the coal act no less than 117 different sizes were prepared and marketed in 1937. In some districts a still greater diversity of sizes was recorded.

Copies of these tables may be had on application to the United States Department of the Interior, Washington, D. C.

FUEL EFFICIENCY

TABLE 32.—*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, 1937	117	31.2
Average, 1938	115	32.4
Pounds per passenger-train car-mile:		
Average, 1919-20	18.5	
Average, 1937	15.1	18.4
Average, 1938	14.9	19.5
Electric-public-utility power plants:		
Pounds per kilowatt-hour, 1919	3.2	
Pounds per kilowatt-hour, 1937	1.4	56.2
Pounds per kilowatt-hour, 1938	1.4	56.2
Iron and steel—pounds coking coal per ton of pig: [1]		
1918	3,577	
1937	2,917	18.5
1938	2,865	19.9
Coke manufacture: Savings of heat values through recovery of gas, tar, light oils, and breeze by extension of byproduct in place of beehive coking, 1913-38, expressed as percent of coal used for all coke in 1938 [2]		18.2

[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.

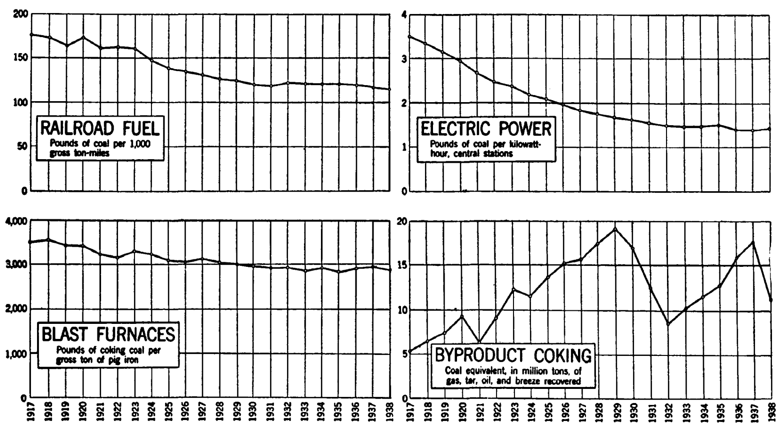

FIGURE 8.—Trends in fuel efficiency in the United States, 1917-38.

DISTRIBUTION

Tables showing the movement of coal to the Great Lakes, tidewater, New England, and certain other major channels of distribution are included in the Monthly Coal Distribution Reports.

Details of distribution by sizes and grade from each origin district to each consuming market area are being published by the Divisions of Research and Statistics, National Bituminous Coal Commission.

STOCKS HELD BY CONSUMERS

TABLE 33.—*Stocks of bituminous coal in hands of commercial consumers and of anthracite and bituminous coal in retail dealers' yards, 1937–38*

Date	Total stock of bituminous coal estimated (net tons)	Days' supply at current rate of consumption on date of stock taking								
		By-product coke plants	Steel plants	Other industrials	Coal-gas plants	Electric utilities	Retail yards, bituminous	Railroads	Total bituminous	Retail yards, anthracite
1937										
Jan. 1	42,926,000	42	31	29	58	59	25	26	31	38
Feb. 1	43,390,000	40	35	29	54	65	22	28	31	37
Mar. 1	46,574,000	42	37	28	52	69	22	31	32	26
Apr. 1	53,153,000	46	43	33	58	75	22	41	37	24
May 1	46,921,000	41	43	32	53	77	32	33	38	31
June 1	45,169,000	39	43	36	55	80	66	32	42	49
July 1	43,936,000	40	47	37	60	72	61	35	43	93
Aug. 1	43,371,000	37	44	41	61	69	66	33	43	122
Sept. 1	43,851,000	36	40	42	59	66	59	33	42	71
Oct. 1	46,032,000	37	39	44	66	69	39	30	41	51
Nov. 1	47,986,000	44	43	43	65	73	40	27	41	65
Dec. 1	48,280,000	53	45	42	75	78	37	29	43	50
Dec. 31	47,074,000	56	44	42	61	79	25	32	40	36
1938										
Jan. 1	47,074,000	56	44	42	61	79	25	32	40	36
Feb. 1	41,967,000	51	41	37	53	82	22	28	37	27
Mar. 1	38,484,000	46	35	33	51	83	22	28	35	26
Apr. 1	35,359,000	43	33	33	51	87	22	28	36	25
May 1	34,102,000	43	36	35	50	97	36	29	41	44
June 1	33,158,000	47	37	39	57	91	53	28	45	58
July 1	33,452,000	51	37	40	63	85	64	27	46	57
Aug. 1	33,615,000	54	35	43	68	81	69	26	47	58
Sept. 1	34,579,000	49	31	41	68	73	52	25	43	63
Oct. 1	36,507,000	47	29	42	61	72	39	24	41	44
Nov. 1	39,024,000	46	26	42	60	71	40	24	40	59
Dec. 1	40,817,000	47	24	39	57	71	34	24	38	51
Dec. 31	40,720,000	49	25	35	54	71	25	24	35	37

IMPORTS AND EXPORTS [5]

TABLE 34.—*Bituminous coal [1] imported for consumption in the United States, 1937–38, by countries and customs districts, in net tons*

	1937	1938		1937	1938
Country			*District*—Continued		
North America: Canada	252,147	240,729	Los Angeles		1,131
Europe:			Maine and New Hampshire	92,718	88,314
France		437	Maryland	232	
United Kingdom	5,513	139	Michigan	153	
Asia: Japan	336		Montana-Idaho	104,381	95,511
			New Orleans		437
	257,996	241,305	Oregon	340	
			St. Lawrence		242
District			Vermont	1,312	2,313
			Virgin Islands	5,282	139
Alaska	10,781	11,634	Washington	42,050	41,344
Dakota	520	162			
Duluth and Superior	227	78		257,996	241,305

[1] Includes slack, culm, and lignite.

[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.

TABLE 35.—*Exports of bituminous coal to Canada and Mexico, the West Indies, and Central America, and "overseas" destinations, 1931–38, in thousands of net tons*

Year	Canada and Mexico	West Indies and Central America [1]	"Overseas" (all other countries)							Grand total
			New-foundland, Miquelon, and Bermuda	South America	Europe	Asia	Africa	Oceania	Total "overseas"	
1931	10,647	755	98	306	246	18	56	---	724	12,126
1932	8,429	235	6	108	3	8	25	(2)	150	8,814
1933	8,600	223	21	174	7	6	6	---	214	9,037
1934	10,213	410	40	203	---	3	---	---	246	10,869
1935	9,044	456	31	197	9	5	---	---	242	9,742
1936	9,912	470	44	163	50	(3)	(4)	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

[1] Includes Bahamas and Panama. Virgin Islands included prior to 1935.
[2] 2 tons [3] 1 ton. [4] 3 tons.

TABLE 36.—*Bituminous coal exported from the United States, 1937–38, by countries, in net tons* [1]

Country	1937	1938
North America:		
Bermuda	6,873	5,253
British Honduras	195	722
Canada	12,047,788	9,559,726
Central America:		
Costa Rica	2	---
Guatemala	631	158
Honduras	456	365
Nicaragua	123	26
Panama	130,943	107,961
Salvador	27	76
Mexico	4,323	991
Miquelon and St. Pierre Islands	5,676	1
Newfoundland and Labrador	38,341	17,703
West Indies:		
British:		
Barbados	---	609
Jamaica	104,152	83,637
Trinidad and Tobago	67,131	42,779
Other British	34,011	19,206
Cuba	371,180	347,565
Dominican Republic	93	74
French	19,958	13,241
Haiti	---	28
Netherlands	3,537	3,218
	12,835,440	10,203,339
South America:		
Argentina	19,617	15,193
Bolivia	36	51
Brazil	209,766	204,294
Chile	153	---
South America—Contd.		
Columbia	39	12
Ecuador	32	49
Guiana:		
British	232	---
Surinam (Netherland)	2,831	4,532
Peru	8,492	2,249
Uruguay	23,727	20,876
Venezuela	104	46
	265,029	247,302
Europe:		
Belgium	3,787	---
France	1,921	11,192
Netherlands	2,881	---
United Kingdom	696	(2)
	9,285	11,192
Asia:		
Ceylon	9,356	---
China	1,341	21,363
Iran	---	6
Japan	211	---
Netherland India	9,116	7,067
Philippine Islands	3,707	---
	23,731	28,436
Africa: Algeria	11,193	---
	11,193	---
Grand total	13,144,678	10,490,269

[1] Amounts stated do not include fuel or bunker coal loaded on vessels engaged in the foreign trade which aggregated 1,831,650 tons in 1937, and 1,352,480 tons in 1938.
[2] Less than 1 ton.

TABLE 37.—*Bituminous coal exported from the United States, 1937–38, by customs districts, in net tons*

District	1937	1938
North Atlantic:		
Maine and New Hampshire	339	189
Massachusetts	------------	2
New York	14,661	3,397
Philadelphia	11,323	9,116
South Atlantic:		
Maryland	62,013	45,171
South Carolina	65,788	77,267
Virginia	964,608	781,287
Gulf Coast:		
Florida	632	14
Mobile	2,967	1,318
New Orleans	1,950	1,649
Mexican border:		
Arizona	310	280
El Paso	3,266	253
San Antonio	53	31
Pacific Coast:		
Los Angeles	8	2
San Diego	36	76
Pacific Coast—Continued.		
San Francisco	75	21,382
Washington	3,293	4,845
Northern border:		
Buffalo	1,162,807	605,487
Chicago	18	------------
Dakota	7,468	7,159
Duluth and Superior	48,446	30,783
Michigan	1,247,994	1,048,498
Montana-Idaho	73	263
Ohio	8,057,839	6,513,272
Rochester	1,113,742	1,042,924
St. Lawrence	374,694	295,341
Vermont	181	122
Wisconsin	------------	112
Miscellaneous:		
Alaska	65	26
Puerto Rico	5	2
Virgin Islands	24	1
	13,144,678	10,490,269

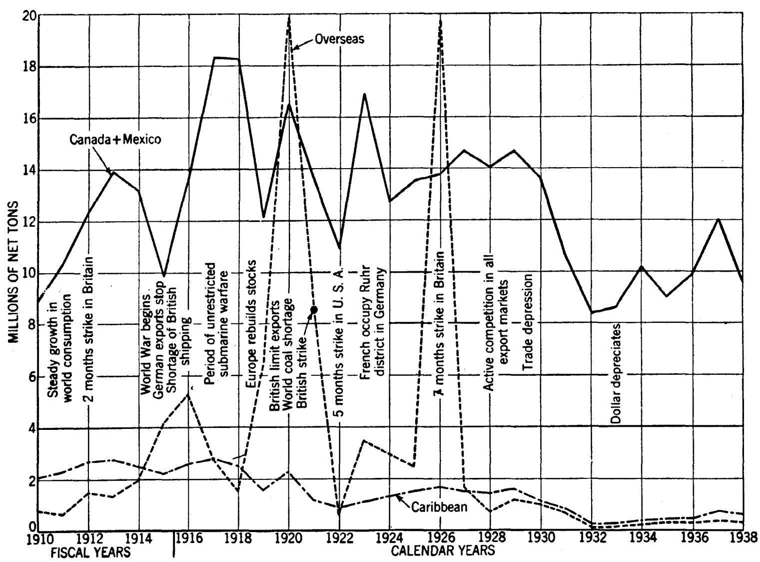

FIGURE 9.—Exports of bituminous coal to Canada and Mexico, the Caribbean, and "overseas" destinations, 1910–38.

Shipments to Alaska, Hawaii, 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, Hawaii, Puerto Rico, and the Virgin Islands. Shipments of bituminous coal to each of these possessions in 1938 were as follows: Alaska, 23,465 net tons; Hawaii, 773; Puerto Rico, 19,967; and Virgin Islands, 93,065. Comparative shipments for 1937 were: Alaska, 24,562 net tons; Hawaii, 8,238; Puerto Rico, 20,465; and Virgin Islands, 68,359.

WORLD PRODUCTION

TABLE 38.—*World production of coal and lignite, 1934–38, by countries, in thousands of metric tons*

[Compiled by R. B. Miller, Bureau of Mines]

Country	1934	1935	1936	1937	1938
North America:					
Canada:					
Coal	9,613	9,358	10,308	11,014	9,778
Lignite	2,916	3,241	3,508	3,352	3,148
Greenland	6	6	5	6	(1)
Mexico	631	990	1,072	912	545
United States:					
Anthracite	51,862	47,317	49,513	46,189	40,872
Bituminous and lignite	326,011	337,809	393,780	401,386	310,625
South America:					
Argentina	(1)	(1)	(1)	(1)	(1)
Brazil	708	757	648	763	883
Chile	1,808	1,900	1,875	1,988	2,061
Colombia	(1)	(1)	(1)	(1)	(1)
Peru	35	85	90	99	115
Venezuela	6	6	6	7	(1)
Europe:					
Albania: Lignite	2	2	3	4	4
Belgium	26,389	26,506	27,867	29,859	29,575
Bulgaria:					
Coal	79	93	102	120	142
Lignite	1,568	1,566	1,524	1,732	1,855
Czechoslovakia:					
Coal	10,789	10,894	12,233	16,778	13,500
Lignite	15,071	15,114	15,949	17,895	13,100
France:					
Coal	47,632	46,213	45,228	44,319	46,502
Lignite	1,025	907	943	1,015	1,057
Germany: [2]					
Coal	124,910	132,379	146,707	171,148	171,786
Lignite	135,995	146,033	160,276	184,709	194,978
Austria:					
Coal	251	261	244	230	226
Lignite	2,851	2,971	2,897	3,242	3,533
Saar [3]	11,318	10,624	11,673	13,365	14,393
Greece: Lignite	104	83	106	131	(1)
Hungary:					
Coal	756	823	827	917	1,040
Lignite	6,199	6,718	7,105	8,055	8,320
Irish Free State	113	115	127	128	120
Italy:					
Coal	374	443	806	964	960
Lignite	409	545	769	1,059	1,327
Netherlands:					
Coal	12,341	11,878	12,803	14,321	13,488
Lignite	92	86	89	143	171
Poland:					
Coal	29,233	28,545	29,748	36,218	38,104
Lignite	26	18	14	19	10
Portugal:					
Coal	203	211	217	249	299
Lignite	15	20	21	23	15
Rumania:					
Coal	228	278	293	303	(1)
Lignite	1,624	1,667	1,672	1,879	(1)
Spain:					
Coal	5,932	7,016	(1)	(1)	(1)
Lignite	299	304	(1)	(1)	(1)
Svalbard (Spitsbergen)	533	709	784	780	(1)
Sweden	415	424	456	460	(1)
Switzerland	3	4	3	4	3
United Kingdom:					
Great Britain	224,269	225,816	232,115	244,268	223,287
Northern Ireland	1	4	5	1	1
U. S. S. R.:					
Coal	61,580	67,998	91,250	92,460	97,700
Lignite	4,819	4,820			
Yugoslavia:					
Coal	387	400	441	428	450
Lignite	3,926	4,028	4,035	4,574	5,287
Asia:					
British Borneo	(1)	1	1	1	1
China	32,725	[4] 26,750	27,050	(1)	(1)
Chosen	1,689	1,999	2,282	2,348	(1)
Federated Malay States	327	383	511	638	486

See footnotes at end of table.

TABLE 38.—*World production of coal and lignite, 1934–38, by countries, in thousands of metric tons*—Continued

Country	1934	1935	1936	1937	1938
Asia—Continued.					
India, British	22,971	23,970	23,548	[5] 25,438	[1]
Indochina	1,591	1,775	2,186	2,308	2,300
Iran	[1]	[1]	[1]	[1]	[1]
Japan:					
Japan proper:					
Coal	35,824	37,674	41,803	[1]	[1]
Lignite	125	109	109	[1]	[1]
Karafuto	1,197	1,516	2,010	[1]	[1]
Taiwan	1,521	1,597	1,744	[1]	[1]
Netherland India	1,033	1,111	1,147	1,364	1,434
Philippine Islands	[1]	[1]	[1]	[1]	[1]
Turkey:					
Coal	2,288	2,340	2,299	2,307	2,559
Lignite	53	73	96	116	[1]
U. S. S. R.:					
Coal	20,511	27,242			
Lignite	8,356	9,000	32,450	34,540	35,190
Sakhalin: Coal	436	[1]			
Africa:					
Algeria	34	38	7	14	13
Belgian Congo: Coal	5	11	14	36	[1]
Morocco, French	36	53	49	107	123
Nigeria	264	262	296	369	368
Portuguese East Africa	22	16	16	19	[1]
Southern Rhodesia	643	695	705	1,029	1,044
Union of South Africa	12,195	13,574	14,842	15,491	16,284
Oceania:					
Australia:					
New South Wales	8,000	8,838	9,347	10,213	9,571
Queensland	972	1,069	1,064	1,138	1,131
Tasmania	115	126	134	93	85
Victoria:					
Coal	363	484	434	262	312
Lignite	2,660	2,257	3,094	3,448	2,718
Western Australia	508	546	574	562	[1]
New Zealand:					
Coal	845	838	873	986	2,300
Lignite	1,248	1,311	1,302	1,329	
Total, all grades	1,284,000	1,324,000	1,445,000	1,540,000	1,439,000
Lignite (total of items shown above)	190,000	204,000	225,000	256,000	262,000
Bituminous and anthracite (by subtraction)	1,094,000	1,120,000	1,220,000	1,284,000	1,177,000

[1] Estimate included in total.
[2] Exclusive of mines in the Saar.
[3] Mines under French control until Mar. 1, 1935.
[4] Production of the most important coal-producing areas.
[5] Excludes coal (about 550,000 metric tons) consumed by the miners.

DETAILED STATISTICS, BY STATES AND COUNTIES

Detailed production and employment statistics are given in table 39 for each county in the United States in which three or more operators produced coal in 1937. If there were less than three producing companies the figures for two or more counties have been combined to avoid disclosing individual returns, unless permission to publish has been granted by the producers.

In this series the reported production is classified according to the principal channels of distribution or use. The distribution schedules (N. B. C. C. form D-1 and D-2), which constituted the primary source material for the 1937 statistics permitted a much more detailed analysis of the movement of coal from producing mines to consumer destinations than has ever been possible heretofore.

The classifications selected for this purpose did not coincide with the groupings that had been used in the annual series for 1936 and earlier years. For purposes of presentation in this report the 1937 figures have been grouped and rearranged in the order that most nearly corresponds to the old series. The resulting data are fairly comparable, therefore, with the statistics for years prior to 1937.

The following descriptions of the classification groups have been taken very largely from the instructions on the 1937 distribution schedules. They are given here to define more clearly the limits to the various groups.

Shipments to tidewater.—"All coal dumped over tidewater piers."

Shipments to Great Lakes.—"All coal dumped over piers on Lake Erie and Lake Ontario."

River and ex-river.—River coal represents all bituminous "Coal moving by river barges whether loaded directly at the mine or first transported from mine to river tipple by rail or truck." Ex-river includes "Coal unloaded from river barges which is shipped inland by rail or truck to points beyond the river port of unloading." Double counting between river and ex-river has been avoided.

All-rail other than railroad fuel.—"All shipments (except railroad fuel) which move from mine to ultimate destination by rail, including car-ferry across Great Lakes and to Cuba." Coal reported by producers as "Shipped to distributors, destinations unknown," has also been included for convenience in the all-rail classification, although a small part of it doubtless moved by lake or tide.

Railroad fuel, all-rail.—"All sales of coal to railroads delivered all-rail, including coal furnished to locomotive tenders at tipple." Note that coal taken by locomotives at tipple was formerly classified with "Other sales to local trade." This item, however, is comparatively small.

Total loaded at mines for shipment by rail or water.—Combines the five preceding items into a total reasonably comparable with the classification in previous reports entitled "Loaded at mines for shipment by rail or water."

Truck deliveries including local sales.—"All coal loaded at mines for delivery by truck or wagon, including local sales." Excludes coal "used by mine employees, mine fuel and coal made into beehive coke or briquets at mine." Neither this nor the following item, "Used by mine employees," is directly comparable with individual items in the old series. If these two items are combined, however, the resulting figure is fairly comparable with the combined total for the two classifications in the old series entitled "Commercial sales by truck or wagon" and "Other sales to local trade, or used by employees, or taken by locomotives at tipple." The discrepancy between the individual groups arises from the inclusion of "Other local sales" with truck deliveries in 1937 rather than with "Coal used by mine employees," as in earlier years. Coal consumed for manufacturing or other industrial uses at the mine is responsible for the more significant shifts between the two groups.

Used by mine employees.—See explanatory note for "Truck deliveries, including local sales," above.

Mine fuel or made into beehive coke at mines.—This item is directly comparable with the former classification "Used for power and heat or made into coke at mines."

The data used 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. This fact should be borne in mind also when the statistics in this report are compared with similar data compiled by State mine departments. Differences arise in large measure 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. Certain State reports also include washery and picking-table refuse. In the statistics here given refuse is excluded.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*

[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. For source of data used in compiling 1937 figures and comparability with earlier years, see sections of this report on "Sources of Data and Acknowledgments" and "Detailed Statistics, by States and Counties."]

ALABAMA

County	Distribution of product—net tons: Loaded at mines for shipment by rail and water: To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Bibb	31,052			305,676	191,925	528,653	7,367	4,758	12,562	560,728	1,174	199	2.40
Blount	42,990			27,369	26,485	96,844	30,470	304	50	127,668	403	161	1.97
Cullman							25,491			25,491	96	186	1.42
Etowah							11,515			11,515	30	226	1.70
Jefferson	70,646			6,034,464	1,078,126	7,183,236	137,932	60,290	69,007	7,438,398	12,739	217	2.69
Marion	1,110			235,397	1,129	237,636	51,890	427	43	278,988	660	182	2.32
St. Clair	73,062			162,556	692,336	927,954	14,387	6,631	27,268	976,240	1,402	222	3.14
Shelby	10,718			253,263	60,079	324,060	67,518	1,160	365	392,629	872	192	2.35
Tuscaloosa				8,691	24,882	33,573	52,921			86,494	417	102	2.04
Walker	119,208		81,291	986,033	1,142,352	2,328,884	92,653	13,283	2,712	2,435,031	4,548	166	3.22
Other counties (Fayette, Jackson, and Winston)	2,138			32,463	64,780	99,381	7,759			107,140	272	167	2.36
Total, Alabama	350,924		81,291	8,045,912	3,282,094	11,760,221	499,903	86,853	[4] 112,007	12,440,322	22,613	200	2.74

ALASKA

Total Alaska				93,144	35,464	128,608		4	[4] 3,251	131,657	123	207	5.16

ARIZONA, CALIFORNIA, GEORGIA, IDAHO, AND OREGON

Total				5,751	5,120	10,871	13,091		[4] 334	24,296	128	165	1.15

ARKANSAS

Franklin				87,770	77,883	165,653	4,042	931	1,626	172,252	386	164	2.73
Johnson				197,316	5,143	202,459	3,487	199	1,863	209,417	777	105	2.58
Logan				444,963	191	445,154	2,989	165	702	451,155	1,233	146	2.50
Pope and Scott				48,987		48,987	2,549	121	371	51,817	183	136	2.08
Sebastian				564,652	38,563	603,215	20,309	108	4,214	626,112	1,674	137	2.73
Total Arkansas				1,343,688	121,780	1,465,468	33,376	1,524	[4] 8,776	1,510,753	4,253	136	2.61

COLORADO

Boulder				166,091	7,380	173,471	336,085	6,961	13,555	528,540	819	176	3.66
Delta				27,762	10,458	38,220	25,777	510	3,604	68,111	92	171	4.33
El Paso				39,072	2,764	41,836	243,104	2,638	5,475	293,053	335	216	4.06
Fremont				199,645	1,071	200,716	291,048	3,158	3,369	503,170	955	185	2.85
Garfield				4,681	18,053	22,734	29,370	50	240	52,394	50	254	4.13
Gunnison				268,162	344,375	612,537	21,951	3,534	12,767	659,163	681	188	5.15
Huerfano				322,495	393,399	715,894	67,111	4,405	2,240	787,683	1,258	178	3.51
Jefferson				134,379		134,379	41,874	1,016	1,797	179,096	140	238	5.37
La Plata				1,220	10,709	11,929	27,802	34	15	40,180	65	206	3.00
Las Animas				776,971	452,077	1,229,048	62,493	4,454	[5] 128,900	1,425,197	1,943	185	3.97
Mesa				8,987	22,586	31,573	45,886	809		78,268	111	199	3.55
Moffat				3,053		3,053	15,146	30		18,229	17	267	4.02
Rio Blanco							4,320			4,320	7	212	2.91
Routt				879,193	103,485	982,678	23,102	5,826	40,629	1,024,621	1,297	157	5.04
Weld				1,022,936	98,704	1,121,640	293,982	15,843	46,511	1,477,673	1,595	176	5.27
Other counties (northern) (Elbert, Jackson, and Larimer)				12,501	5,118	17,619	12,290	465	1,248	31,622	45	206	3.41
Other counties (southern) (Montezuma, Montrose, and Pitkin)				1,165		1,165	14,632	94		15,891	22	207	3.48
Total Colorado				3,868,313	1,470,179	5,338,492	1,555,973	49,827	[5] 260,350	7,187,211	9,432	181	4.21

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

ILLINOIS

County	Distribution of product—net tons: Loaded at mines for shipment by rail and water: To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Bureau	----	----	----	8,748	----	8,748	54,159	2,725	4,496	70,527	295	188	1.27
Christian	----	----	----	4,088,876	586,722	4,675,598	148,346	4,105	20,732	4,858,252	2,524	189	10.17
Clinton	----	----	----	84,841	7,518	92,359	150,358	5,072	15,803	264,209	440	136	4.43
Edgar	----	----	----	17,260	9,490	26,750	32,401	337	3,271	62,759	87	126	5.71
Franklin	----	----	53,872	6,396,135	3,188,694	9,638,701	64,242	35,004	127,978	9,947,541	6,550	169	8.97
Fulton	----	----	----	1,911,459	961,823	2,873,282	409,487	1,689	16,462	3,308,849	1,683	181	10.83
Gallatin	----	----	----	----	----	----	29,925	----	1,865	31,790	68	132	3.54
Greene	----	----	----	----	----	----	3,123	----	12	3,135	22	157	.91
Grundy	----	----	----	3,407	----	3,407	163,675	----	1,210	168,292	247	123	5.54
Henry	----	----	----	368,644	184,232	552,876	146,603	1,187	6,400	709,062	529	210	6.37
Jackson	----	----	----	1,210,942	355,764	1,566,706	116,459	3,433	2,009	1,688,092	914	194	9.54
Knox	----	----	----	386,513	279,664	666,177	165,895	2,642	5,547	842,227	593	208	6.82
La Salle	----	----	----	142,883	11,340	154,223	292,754	4,143	12,748	464,596	876	157	3.38
Livingston and Woodford	----	----	----	14,757	----	14,757	64,015	2,556	4,795	86,992	345	142	1.78
Macoupin	----	----	----	503,154	2,645,133	3,148,287	128,081	34,253	111,407	3,436,884	2,531	193	7.03
Madison	----	----	----	697,309	85,889	783,198	793,753	7,317	55,665	1,639,109	1,725	171	5.56
Marshall	----	----	----	----	----	----	5,288	----	----	5,288	22	160	1.51
Menard	----	----	----	----	----	----	133,870	----	4,480	138,350	174	207	3.84
Mercer	----	----	----	----	----	----	24,734	----	1,363	26,097	94	136	2.04
Montgomery	----	----	----	555,625	269,218	824,843	48,446	6,475	34,626	914,489	692	156	8.45
Peoria	----	----	----	49,355	998,010	1,047,365	418,584	10,769	4,956	1,481,844	1,724	168	5.12
Perry	----	----	----	2,085,404	1,509,736	3,595,140	80,159	5,920	45,323	3,762,825	1,890	175	11.38
Randolph	----	----	----	600,265	508,813	1,109,078	97,921	3,737	19,686	1,230,863	764	148	10.91
Rock Island	----	----	----	----	----	----	43,838	----	223	44,061	84	184	2.86
St. Clair	----	----	----	794,592	347,015	1,141,607	1,490,967	13,779	51,654	2,695,310	2,803	155	6.20
Saline	----	----	2,726	2,416,896	845,431	3,265,053	62,121	12,464	56,068	3,387,219	3,785	136	6.59
Sangamon	----	----	----	1,118,425	787,247	1,905,672	648,311	10,116	22,434	2,586,368	3,487	158	4.69
Schuyler	----	----	----	----	----	----	61,652	----	1,052	62,704	107	237	2.47

Shelby							9,676		361	10,037	77	122	1.07
Stark							18,403		454	18,857	52	220	1.65
Tazewell				23,461	35,640	59,101	225,202	568	963	285,448	527	172	3.15
Vermilion				958,211	763,559	1,721,770	472,975	14,279	12,136	2,262,806	2,373	183	5.20
Wabash							8,683		160	8,843	31	124	2.30
Washington				42,771	207,896	250,667	64,047	2,965	16,428	334,406	394	147	5.76
Williamson			29,035	1,601,309	620,677	2,251,021	429,491	9,733	59,747	2,765,264	2,139	163	7.92
Other counties [6]				1,098,003	350,285	1,448,288	503,229	8,049	35,872	1,998,243	1,801	159	6.97
Total Illinois			85,633	27,179,245	15,559,796	42,824,674	7,610,873	203,317	[4] 758,386	51,601,638	42,449	168	[7] 7.25

INDIANA

Clay				716,753	175,327	892,080	357,356	845	3,851	1,256,247	887	177	8.00
Daviess							45,311		690	46,001	51	237	3.80
Dubois							25,424			25,424	50	194	2.62
Fountain							39,637			39,637	53	148	5.04
Gibson				936,542	196,387	1,132,929	131,746	1,586	23,918	1,289,822	767	178	9.43
Greene				1,101,756	890,804	1,992,560	84,354	1,132	22,862	2,099,896	1,064	171	11.56
Knox				1,090,141	647,732	1,737,873	164,873	8,787	17,804	1,933,215	1,101	204	8.60
Martin							22,167			22,167	45	200	2.46
Owen				130,254	15,761	146,015	13,820			159,835	99	155	10.45
Parke							109,792	50	4,087	113,929	197	173	3.34
Pike				2,058,781	1,083,599	3,142,380	49,192	862	17,105	3,208,339	1,051	199	15.36
Spencer				11,025	2,458	13,483	8,439			22,046	55	84	4.77
Sullivan				1,267,096	557,511	1,824,607	55,619	5,896	29,274	1,916,997	1,673	153	7.49
Vanderburgh				29,635	72,739	102,374	47,507	100	1,100	151,081	177	203	4.20
Vermillion				179,803	289,562	469,365	149,400	1,060	16,877	637,538	939	128	5.33
Vigo				1,701,865	1,229,462	2,931,327	471,372	5,864	53,298	3,465,691	2,219	177	8.80
Warrick				887,554	273,751	1,161,305	191,869	1,864	3,800	1,358,516	782	178	9.76
Other counties (Perry and Warren)							18,393			18,393	28	187	3.51
Total Indiana				10,111,205	5,435,093	15,546,298	1,986,271	28,046	[4] 194,666	17,764,774	11,238	174	[7] 9.10

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

IOWA

County	Distribution of product—net tons										Average number of employees	Average number of days mines operated	Average tons per man per day
	Loaded at mines for shipment by rail and water						Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]			
	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total							
Adams							28,250		20	28,270	180	151	1.04
Appanoose				311,044	131,454	442,498	156,388	3,871	175	602,846	1,925	131	2.39
Boone				153,830	82,762	236,592	97,507	7,918	1,913	343,930	987	142	2.45
Dallas				215,474	70,754	286,228	96,098	7,394	1,720	393,047	703	182	3.08
Greene							40,392		230	40,622	84	102	4.30
Guthrie							22,552		18	22,570	101	156	1.43
Jasper							42,271	100	1,698	44,069	158	91	3.06
Keokuk							10,181		25	10,206	26	94	4.18
Lucas				3,540	401,434	404,974	14,602	7,576	4,766	431,918	825	133	3.94
Mahaska				87,266	3,743	91,009	136,007	1,435	1,731	230,297	282	174	4.71
Marion				60,734	12,009	72,743	392,961	2,892	2,113	470,955	916	156	3.29
Monroe				86,350	21,719	108,069	72,588	7,172	1,681	189,352	387	156	3.13
Page							39,563		25	39,588	143	162	1.71
Polk				59,998	5,164	65,162	360,988	4,175	5,232	435,557	1,039	153	2.74
Van Buren				64		64	18,121		40	18,225	52	169	2.08
Wapello				12,275		12,275	120,397	100	1,627	134,414	353	140	2.73
Warren				10,595	594	11,189	91,473	1,711	2,668	107,019	270	116	3.41
Wayne							22,530	400	30	22,960	104	150	1.47
Webster							36,468		190	36,658	91	164	2.45
Other counties (Davis, Jefferson, and Taylor)				370		370	33,668	493	20	34,551	94	163	2.25
Total Iowa				1,001,540	729,633	1,731,173	1,833,005	45,237	[4] 25,922	3,637,054	8,720	146	2.87

KANSAS

County	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Bourbon				39,124	51	39,175	24,068	46		63,289	99	104	6.12
Cherokee				201,552	81,330	282,882	32,046	2,111	2,564	319,603	272	138	8.52
Crawford				1,400,433	718,094	2,118,527	143,492	3,904	13,046	2,278,664	2,064	168	6.59
Labette							16,443			16,443	29	156	3.63
Linn				3,550	2,100	5,650	27,758		159	33,567	115	118	2.48
Osage				628	1,640	2,268	87,685	49		90,002	494	129	1.41
Other counties (Franklin, Leavenworth, and Neosho)				71,664		71,664	19,328			90,992	501	284	.64
Total Kansas [8]				1,716,951	803,215	2,520,166	350,820	6,110	[4] 15,769	2,892,560	3,574	173	4.68

Eastern district:													
Bell	---	99, 203	---	1, 404, 656	357, 582	1, 861, 441	80, 509	14, 374	2, 363	1, 961, 446	3, 004	180	3. 62
Boyd	---	---	---	7, 831	3, 971	11, 802	30, 613	282	---	42, 697	124	145	2. 37
Breathitt	---	---	---	6, 083	41, 426	47, 509	---	150	300	48, 004	157	109	2. 81
Clay	---	---	---	115, 537	942	116, 479	9, 581	---	---	126, 060	264	178	2. 69
Floyd	48, 637	1, 426, 886	---	2, 560, 131	273, 425	4, 309, 079	9, 889	11, 783	15, 247	4, 351, 681	5, 725	201	3. 78
Harlan	460	3, 191, 024	---	9, 874, 696	783, 945	13, 850, 125	27, 516	78, 738	16, 588	14, 039, 371	13, 409	226	4. 64
Jackson	---	---	---	---	---	---	208, 157	---	5, 100	213, 257	369	215	2. 69
Johnson	7, 482	267, 664	---	552, 288	12, 902	840, 336	3, 200	6, 578	8, 153	858, 607	1, 033	213	3. 89
Knott	---	118, 996	---	271, 924	39, 243	430, 163	---	1, 943	---	431, 305	518	168	4. 95
Knox	---	31, 432	---	503, 216	66, 072	600, 720	4, 800	3, 078	4, 000	616, 889	747	239	3. 45
Laurel	---	---	---	550	---	550	21, 591	---	---	22, 141	102	119	1. 82
Lee	---	---	---	---	---	---	8, 165	---	---	8, 165	35	126	1. 85
Letcher	245, 639	1, 712, 482	---	2, 240, 800	265, 400	4, 464, 321	1, 606	37, 584	6, 537	4, 516, 375	5, 558	199	4. 08
Martin	---	400	---	100, 295	175, 479	276, 174	281	---	---	276, 455	351	152	5. 18
Perry	---	463, 343	---	3, 252, 955	510, 462	4, 226, 760	74, 194	31, 173	2, 064	4, 338, 002	5, 315	170	4. 80
Pike	172, 516	1, 818, 448	---	2, 440, 659	1, 026, 665	5, 458, 288	50, 003	27, 082	24, 564	5, 557, 884	5, 536	225	4. 46
Pulaski	---	---	---	---	---	---	20, 358	---	---	20, 358	34	171	3. 50
Rockcastle	---	---	---	---	---	---	18, 054	---	---	18, 054	54	109	3. 07
Whitley	---	24, 138	---	219, 007	30, 510	273, 655	28	4, 265	7, 802	288, 082	761	151	2. 51
Wolfe	---	---	---	---	---	---	4, 135	---	---	4, 135	17	125	1. 95
Other counties (Carter, Greenup, McCreary, Magoffin, and Morgan)	---	15, 064	---	589, 362	164, 660	769, 086	11, 175	4, 325	---	784, 586	1, 098	178	4. 02
	474, 734	9, 169, 080	---	24, 139, 990	3, 752, 684	37, 536, 488	583, 855	221, 355	92, 718	38, 523, 554	44, 211	204	4. 27
Western district:													
Butler	---	---	---			---	45, 794	---	---	45, 794	208	124	1. 78
Daviess	---	---	---	---	---	---	103, 021	---	1, 725	104, 746	184	154	3. 69
Henderson	---	---	---	7, 056	---	7, 056	111, 855	950	9, 650	130, 417	269	151	3. 22
Hopkins	1, 225	---	---	1, 919, 713	1, 168, 955	3, 089, 893	183, 350	7, 582	19, 741	3, 304, 203	3, 970	152	5. 46
Muhlenberg	---	---	---	1, 411, 774	738, 476	2, 150, 250	99, 489	7, 836	37, 586	2, 307, 103	3, 173	142	5. 11
Ohio	---	---	9, 755	308, 022	124, 278	442, 055	16, 818	3, 479	6, 296	470, 839	933	110	4. 58
Union	---	---	202, 523	256, 953	78, 039	537, 515	99, 066	4, 860	18, 192	661, 272	779	164	5. 17
Webster	---	---	33, 650	838, 351	500, 085	1, 372, 086	34, 784	5, 302	15, 979	1, 428, 151	1, 670	146	5. 87
Other counties (Christian, and McLean)	---	---	---	81, 343	---	81, 343	26, 427	395	2, 000	110, 365	199	129	4. 31
	1, 225	---	245, 928	4, 823, 212	2, 609, 833	7, 680, 198	720, 604	30, 404	111, 169	8, 562, 890	11, 385	145	5. 19
Total Kentucky	475, 959	9, 169, 080	245, 928	28, 963, 202	6, 362, 517	45, 216, 686	1, 304, 459	251, 759	[4] 203, 887	47, 086, 444	55, 596	192	4. 41

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

MARYLAND

County	Distribution of product—net tons: Loaded at mines for shipment by rail and water: To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Allegany	35,802			712,036	14,215	762,053	223,782	4,922	340	967,264	1,694	188	3.03
Garrett	97,063			230,874	193,135	521,072	48,611	1,877	8,215	581,716	831	190	3.68
Total Maryland	132,865			942,910	207,350	1,283,125	272,393	6,799	[4] 8,555	1,548,980	2,525	189	3.25

MICHIGAN

County	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Bay				36,936	7,229	44,165	57,860	2,279	5,044	113,573	303	154	2.43
Saginaw				8,484		8,484	129,526	940	10,900	149,850	342	164	2.66
Shiawassee							103,670	1,450	2,400	107,520	222	151	3.20
Other counties (Eaton, Midland, and Tuscola)				92,099	36,221	128,320	51,801	4,004	6,091	191,319	476	122	3.28
Total Michigan				137,519	43,450	180,969	342,857	8,673	[4] 24,435	562,262	1,343	145	2.88

MISSOURI

County	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Adair				56,314	14,083	70,397	95,166	1,346	3,022	171,088	503	133	2.56
Audrain and Howard							4,210			4,210	35	102	1.18
Barton				415,542	81,286	496,828	10,539	460		509,134	208	172	[9] 14.22
Bates				553,263	109,823	663,086	22,183	149	4,736	690,154	327	169	[9] 12.52
Boone							15,627			15,627	76	149	1.38
Callaway				700		700	84,720			85,420	84	224	4.54
Clay				3,432		3,432	97,594		1,690	102,716	401	131	1.95
Dade and Jasper							13,106			13,106	35	114	3.29

Daviess, Grundy, and Harrison				369		369	37,204		50	37,623	131	175	1.64
Henry				287,176	225,232	512,408	101,580	1,903	6,082	626,990	402	186	[9] 8.39
Johnson							6,694			6,694	23	99	2.95
Lafayette				51,303	154,866	206,169	103,727	4,773	3,955	318,624	1,111	158	1.82
Lincoln and Warren							2,672		24	2,696	10	171	1.57
Linn				21,995	3,223	25,218	75,877	521		101,616	365	174	1.60
Macon				262,837	79,257	342,094	34,008	1,382	2,479	382,023	315	173	7.01
Putnam							73,934			73,934	337	122	1.80
Ralls							23,795			23,795	57	199	2.10
Randolph				320,731	139,862	460,593	72,899	1,642	422	535,662	452	201	[9] 5.90
Ray				52,315	61,465	113,780	134,167	2,434		251,207	1,260	117	1.71
Vernon				49,269	3,879	53,148	63,689		1,929	118,766	169	169	[9] 4.16
Other counties (Chariton, Platte, St. Clair, and Schuyler)				2,202		2,202	14,987	808	2,312	20,309	135	125	1.21
Total Missouri [8]				2,077,448	872,976	2,950,424	1,088,378	15,418	[4] 26,701	4,091,394	6,436	152	4.18

MONTANA

Blaine							15,327			15,327	21	202	3.61
Carbon				172,423	182,271	354,694	29,879	3,145	742	389,036	290	195	6.88
Cascade				2,245	386,700	388,945	45,464	39	147	434,595	301	229	6.30
Chouteau							8,033			8,033	23	155	2.26
Daniels, Roosevelt, and Valley [10]							[10] 12,287	([10])	50	12,337	17	162	4.47
Fergus							3,485			3,485	10	173	2.02
Hill							11,019	30	30	11,079	32	168	2.06
Judith Basin							3,269	20	23	3,312	17	128	1.52
Musselshell				396,540	377,061	773,601	28,006	3,501	2,412	787,665	620	160	7.92
Pondera							4,295	30		4,325	17	214	1.19
Richland [10]				[10] 4,000		4,000	[10] 10,667	([10])		14,667	25	153	3.84
Rosebud					1,246,518	1,246,518	100	1,400	819	1,248,837	67	253	[9] 73.61
Sheridan [10]							[10] 16,977	([10])	42	17,019	26	179	3.66
Other lignite counties (Custer, Dawson, and Wibaux) [10]							[10] 10,278	([10])	10	10,288	13	180	4.40
Other bituminous counties (Phillips, Powder River, and Toole)							5,158	30		5,188	24	124	1.75
Total Montana				575,208	2,192,550	2,767,758	204,244	8,195	[4] 4,275	2,965,193	1,503	186	10.62

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

NEW MEXICO

County	Distribution of product—net tons: Loaded at mines for shipment by rail and water: To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]	Average number of employees	Average number of days mines operated	Average tons per man per day
Colfax				178,049	613,961	792,010	23,711	5,382	3,059	837,530	984	184	4.62
Lincoln and Socorro							4,076		290	4,366	26	159	1.06
McKinley				309,827	304,946	614,773	40,708	5,580	29,813	691,182	1,137	210	2.90
Rio Arriba				1,993	15,767	17,760	4,806		90	22,656	40	207	2.73
Other counties (Sandoval, San Juan, and Santa Fe)				112,219	15,850	128,069	13,541		14,166	159,221	421	260	1.46
Total New Mexico				602,088	950,524	1,552,612	86,842	10,962	[4] 47,418	1,714,955	2,608	208	3.17

NORTH DAKOTA (LIGNITE) [10]

County	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel	Railroad fuel all-rail	Total	Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production	Average number of employees	Average number of days mines operated	Average tons per man per day
Adams				8,965		8,965	25,171		25	34,161	68	159	3.16
Billings, Bowman, and Slope				193		193	10,501			10,694	15	141	5.05
Burke				194,643		194,643	49,324		55	244,022	84	215	[9] 13.48
Burleigh				219,715		219,715	34,155		30	253,900	92	242	[9] 11.41
Divide				191,370		191,370	18,434			209,804	71	220	[9] 13.46
Dunn							6,980		400	7,380	20	99	3.73
Golden Valley							2,479		20	2,499	7	129	2.78
Grant				6,029		6,029	22,758		650	29,437	40	139	5.30
Hettinger				230		230	16,561		200	16,991	35	165	2.94
McKenzie							4,404			4,404	12	130	2.81
McLean				98,150		98,150	53,520		298	151,968	171	145	6.14
Mercer				504,984		504,984	80,670		2,440	588,094	378	172	9.07
Morton				9,611		9,611	18,581		3,025	31,217	59	109	4.88
Mountrail				90		90	12,313		25	12,428	27	193	2.39
Oliver							8,916			8,916	18	90	5.50
Stark				228		228	126,652		2,502	129,382	75	286	6.02
Ward				342,080		342,080	128,566		75	470,721	228	207	[9] 9.97
Williams				928		928	43,826		65	44,819	75	151	3.96
Total North Dakota				1,577,216		1,577,216	663,811		[4] 9,810	2,250,837	1,475	181	8.41

OHIO

Athens		245, 470		1, 841, 506	825, 654	2, 912, 630	40, 688	4, 934	25, 655	2, 989, 111	4, 794	153	4. 07
Belmont		1, 800, 258	2, 171	2, 505, 936	3, 196, 493	7, 504, 858	297, 208	11, 990	28, 005	7, 836, 059	8, 478	207	4. 46
Carroll		13, 945		68, 239	27, 399	109, 583	161, 079	166	2, 040	273, 267	460	158	3. 77
Columbiana				95, 298	43, 921	139, 219	296, 533	940	2, 524	441, 806	520	181	4. 70
Coshocton				46, 500	4, 608	51, 108	157, 184	662	1, 387	210, 836	326	171	3. 77
Gallia							47, 332		15	47, 547	68	268	2. 61
Guernsey		68, 747		334, 204	337, 968	740, 919	130, 690	3, 499	1, 030	879, 877	1, 206	184	3. 97
Harrison		283, 570		1, 691, 945	568, 288	2, 543, 803	56, 337	1, 675	6, 108	2, 608, 754	2, 006	210	6. 19
Hocking		488		95, 136	56	95, 680	114, 716	448	410	211, 254	320	156	4. 23
Holmes							36, 955	240	69	37, 294	68	166	3. 31
Jackson				64, 760	21, 444	86, 204	134, 772	235	3, 710	228, 500	362	175	3. 61
Jefferson		580, 018		2, 050, 207	1, 602, 883	4, 233, 108	396, 606	7, 826	27, 440	4, 664, 345	4, 592	198	5. 14
Lawrence				365		365	93, 018	24		93, 407	201	194	2. 40
Mahoning				219		219	127, 282	249	7, 302	136, 377	222	181	3. 40
Medina							9, 977		266	10, 243	15	225	3. 03
Meigs		2, 376	1, 534	25, 275	182	29, 367	102, 904	286		132, 557	218	200	3. 04
Morgan		15, 453		106, 064	75, 173	196, 690	3, 054	801		200, 545	559	125	2. 87
Muskingum			726, 754			726, 754	164, 602	430	4, 561	899, 543	1, 101	179	4. 56
Noble		99, 537		84, 217	278, 436	462, 190	8, 157	1, 763	10, 845	486, 806	594	205	4. 01
Perry		20, 363		371, 378	244, 922	636, 663	220, 131	1, 992	237	860, 652	1, 542	142	3. 93
Portage							24, 006		730	24, 736	49	191	2. 65
Scioto							1, 421			1, 421	14	67	1. 52
Stark				9, 575		9, 575	569, 492	480	425	583, 685	695	181	4. 64
Summit							24, 451		1, 150	25, 601	71	160	2. 25
Tuscarawas		7, 500		193, 353	63, 293	264, 146	904, 032	5, 773	3, 137	1, 181, 159	1, 624	178	4. 10
Vinton				25, 630	23, 470	49, 100	44, 185	75	1, 492	95, 677	148	163	3. 97
Washington							3, 108			3, 108	9	137	2. 51
Wayne							13, 688		12	13, 700	32	195	2. 19
Total Ohio		3, 137, 725	730, 459	9, 609, 807	7, 314, 190	20, 792, 181	4, 183, 608	44, 488	[4] 128, 550	25, 177, 867	30, 294	185	4. 49

OKLAHOMA

Coal							21, 126			21, 126	84	133	1. 89
Craig							3, 532			3, 532	19	97	1. 92
Haskell				4, 531	44, 794	49, 325	266		1, 051	50, 642	115	100	[9] 4. 39
Latimer				22, 797	3, 241	26, 038	2, 403	50	638	29, 229	125	96	2. 43
LeFlore				367, 728	10, 011	377, 739	24, 797	2, 451	1, 070	406, 057	1, 093	141	2. 64
Muskogee				4, 805		4, 805	5, 830			10, 635	46	82	2. 82
Okmulgee				191, 393	123, 256	314, 649	28, 030	367	947	343, 597	616	146	3. 82
Pittsburg				200, 877	7, 252	208, 129	18, 714	632	3, 448	231, 112	674	154	2. 23
Tulsa				26, 429	16, 607	43, 036	23, 156	478		66, 770	125	207	2. 58
Other counties (Rogers and Wagoner)				308, 755	79, 172	387, 927	41, 053	580	8, 035	437, 595	250	135	[9] 12. 96
Total Oklahoma				1, 127, 315	284, 333	1, 411, 648	168, 907	4, 558	[4] 15, 189	1, 600, 295	3, 147	142	3. 58

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

PENNSYLVANIA (BITUMINOUS)

County	Distribution of product—net tons										Average number of employees	Average number of days mines operated	Average tons per man per day
	Loaded at mines for shipment by rail and water						Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for [3]			
	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel [1]	Railroad fuel all-rail [2]	Total							
Allegheny	102, 273	3, 230, 633	1, 017, 063	5, 959, 271	1, 535, 033	11, 844, 273	3, 197, 386	64, 774	64, 036	15, 218, 351	15, 654	209	4. 65
Armstrong	3, 653	482, 204		833, 185	1, 460, 329	2, 779, 371	142, 298	8, 819	1, 863	2, 933, 541	3, 808	178	4. 33
Beaver					702	702	133, 908	76	290	134, 976	317	192	2. 22
Bedford	5, 972			95, 730	7, 223	108, 925	307, 511	621	[11] 65, 012	482, 237	994	169	2. 86
Blair	78, 899			26, 802	29, 917	135, 618	92, 752	1, 953	[11] 4, 212	234, 535	502	185	2. 53
Butler		42, 573		444, 551	118, 041	605, 165	248, 973	2, 087	5, 092	862, 139	1, 597	171	3. 15
Cambria	5, 408, 546	46, 562	77, 727	5, 895, 488	1, 280, 102	12, 708, 425	1, 857, 089	47, 650	[11] 186, 648	14, 818, 927	21, 285	194	3. 60
Center	104			360, 061	9, 300	369, 465	167, 440	210	193	537, 308	957	201	2. 79
Clarion				208, 494	922, 831	1, 131, 325	187, 918	946	145	1, 321, 891	1, 902	211	3. 30
Clearfield	370, 507	141, 176		2, 011, 736	405, 965	2, 929, 384	258, 520	3, 947	18, 981	3, 214, 145	5, 792	178	3. 12
Clinton							47, 414	511	842	48, 767	82	229	2. 59
Elk	1, 010	8, 902		238, 840	279, 132	527, 884	73, 079	4, 788	124	605, 837	1, 108	181	3. 02
Fayette	307, 309	1, 265, 461	12, 066, 898	2, 784, 324	977, 927	17, 401, 919	473, 241	60, 401	[11] 2, 871, 184	20, 820, 042	20, 900	209	4. 76
Greene		894, 425	2, 699, 844	886, 813	76, 763	4, 557, 845	7, 646	20, 507	24, 830	4, 607, 642	4, 626	200	4. 98
Huntingdon	60, 167			326, 182	13, 806	400, 155	65, 846	3, 511	7, 694	482, 593	1, 025	158	2. 98
Indiana	503, 697	792, 835		2, 094, 135	2, 594, 929	5, 985, 596	286, 938	13, 059	[11] 383, 537	6, 667, 054	8, 087	192	4. 29
Jefferson	192, 666	161, 850		852, 590	891, 525	2, 098, 631	76, 764	5, 364	9, 565	2, 192, 193	2, 917	213	3. 53
Lawrence		27, 717		175, 114		202, 831	58, 107	2, 075	3, 845	265, 288	485	221	2. 48
Lycoming				6, 702	6, 107	12, 809	57, 313	74	639	70, 835	162	221	1. 98
McKean							7, 262		15	7, 277	22	161	2. 06
Mercer		21, 866		138, 994		160, 860	146, 839	3, 239	5, 977	318, 813	627	180	2. 83
Somerset	1, 422, 435		273, 853	2, 531, 900	750, 027	4, 978, 215	123, 971	32, 835	93, 437	5, 239, 328	7, 921	182	3. 63
Tioga	46, 142			36, 082	18, 193	100, 417	62, 942	1, 470	4, 675	170, 318	597	119	2. 39
Venango				161		161	30, 822		5	30, 988	92	166	2. 03
Washington	1, 238	3, 176, 307	5, 109, 458	6, 584, 133	3, 551, 384	18, 422, 520	481, 522	69, 896	39, 033	18, 895, 224	20, 204	216	4. 32
Westmoreland	275, 605	1, 150, 472		3, 948, 383	3, 787, 383	9, 161, 843	798, 472	59, 268	[11] 646, 198	10, 674, 423	11, 973	194	4. 59
Other counties (Bradford and Fulton)	23, 462			109, 482	725	133, 669	8, 016	1, 036	3, 190	147, 617	261	191	2. 96
Total Pennsylvania	8, 803, 685	11, 442, 983	21, 244, 843	36, 549, 153	18, 717, 344	96, 758, 008	9, 399, 989	409, 117	[11] 4, 441, 262	111, 002, 289	133, 897	199	4. 16

SOUTH DAKOTA (LIGNITE) [10]

Dewey and Harding				26,444		26,444	15,274			41,718	29	194	7.40
Meade							967		5	972	8	114	1.06
Perkins							4,289			4,289	10	122	3.52
Total South Dakota				26,444		26,444	20,530		[4] 5	46,979	47	165	6.05

TENNESSEE

Anderson		21,806		419,553	488,304	929,663	37,719	7,556	6,024	981,240	1,424	179	3.84
Campbell		116,548		908,121	341,933	1,366,602	30,236	8,687	1,335	1,406,661	2,239	199	3.15
Claiborne		51,658		386,455	550,159	988,272	26,903	5,622	8,250	1,029,507	1,516	186	3.66
Cumberland				31,613		31,613	8,861		4,000	44,474	99	182	2.47
Fentress				224.291	73,254	297,545	6,491	4,284	9,157	317,477	470	217	3.11
Hamilton							20,509	200		20,709	46	149	3.01
Marion				226,198	202,436	428,634	14,960	3,398	1,312	448,304	747	190	3.17
Morgan				159,361	113,452	272,813	14,823	1,634	[12] 12,934	302,204	844	255	1.40
Overton							6,088		25	6,113	29	88	2.40
Scott				6,933	82,126	89,059	6,692	787	2,396	100,346	157	192	3.32
Van Buren							19,617		98	19,715	53	207	1.79
White							4,936			4,936	23	95	2.26
Other northeastern counties (Putnam and Roane)				5,567	1,035	6,602	10,716		55	17,373	50	167	2.08
Other southeastern counties (Bledsoe, Grundy, Rhea, and Sequatchie)				173,115	228,646	401,761	80,503	3,561	[12] 27,580	513,412	768	163	4.10
Total Tennessee		190,012		2,541,207	2,081,345	4,812,564	289,054	35,729	[12] 73,166	5,212,471	8,465	195	3.17

TEXAS

Bituminous:													
Palo Pinto, Webb, Wise, and Young				20,220	11,531	31,751	9,725	49	2,770	44,060	292	165	.92
Lignite:[10]													
Bastrop, Bexar, and Milam				153,403		153,403	4,653		448	158,504	149	162	6.58
Harrison, Henderson, Titus, and Wood				676,639		676,639	25,663		5,486	707,788	378	240	7.81
Total lignite				830,042		830,042	30,316		5,934	866,292	527	218	7.56
Total Texas				850,262	11,531	861,793	40,041	49	[4] 8,704	910,352	819	199	5.59

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

UTAH

County	Distribution of product—net tons										Average number of employees	Average number of days mines operated	Average tons per man per day
	Loaded at mines for shipment by rail and water						Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for[3]			
	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel[1]	Railroad fuel all-rail[2]	Total							
Carbon	12,180			2,436,924	608,010	3,057,114	155,242	17,027	[13] 16,949	3,229,809	2,928	189	5.85
Emery				253,536	127,457	380,993	90,548	1,397	1,354	474,689	356	195	6.83
Iron and Kane							3,839			3,839	8	143	3.36
Summit				4,000		4,000	26,018	168		31,972	41	198	3.95
Other counties (Grand, San Pete, Sevier, and Uintah)				19,976	38,320	58,296	10,763	267	50	69,167	84	192	4.30
Total Utah	12,180			2,714,436	773,787	3,500,403	286,410	18,859	[13] 18,353	3,809,476	3,417	189	5.88
VIRGINIA													
Buchanan	627,470	737,959		2,033,298	190,779	3,589,506	4,250	4,729	1,820	3,601,509	3,391	211	5.04
Dickenson	14,083	389,886		1,024,243	295,159	1,723,371	7,363	9,131	567	1,742,814	1,549	258	4.36
Lee	105	46,091		864,276	331,495	1,241,967	30,456	11,344	669	1,285,830	1,937	198	3.36
Montgomery and Pulaski [14]				[14] 163,604	([14])	163,604	[14] 32,173	([14])	8,356	204,133	577	183	1.93
Russell and Scott	17,191			370,097	189,435	576,723	63,635	9,587	1,214	649,486	1,035	160	3.92
Tazewell	840,920	368,380		1,639,986	51,548	2,900,834	85,168	20,809	8,949	3,009,521	3,650	204	4.03
Wise	507,339	1,303		1,292,809	1,019,559	2,821,010	23,183	24,380	[15] 429,151	3,301,946	4,355	181	4.19
Total Virginia	2,007,108	1,543,619		7,388,313	2,077,975	13,017,015	246,228	79,980	[15] 450,726	13,795,239	16,494	200	4.18
WASHINGTON													
King	7,472			376,773	11,649	395,894	327,376	3,596	487	730,233	1,200	206	2.95
Kittitas	2,166			277,848	500,793	780,807	39,693	12,417	12,766	898,506	1,039	225	3.84
Lewis				7,061	3,051	10,112	26,138		575	36,825	65	152	3.72
Pierce	2,104			52,303	625	55,032	18,405	581	575	64,906	299	88	2.46
Other counties (Thurston and Whatcom)	4,643			196,848	1,688	203,179	59,239	1,765	6,796	270,979	279	253	3.83
Total Washington	16,385			910,833	517,806	1,445,024	470,851	18,359	[4] 21,199	2,001,449	2,882	204	3.40

Barbour	3, 278	975		278, 285	1, 332, 752	1, 615, 290	9, 311	1, 203	950	1, 626, 030	1, 619	186	5. 39
Boone	54, 044	954, 453		2, 095, 356	628, 778	3, 732, 631	3, 107	24, 821	2, 843	3, 771, 776	3, 598	208	5. 05
Braxton				11, 256	19, 571	30, 827	5, 308	191		36, 326	55	160	4. 14
Brooke			33, 733	194, 340	204, 867	432, 940	989, 103	3, 934	205	1, 427, 789	1, 428	197	5. 08
Clay	24, 223	67, 173		768, 576	53, 332	913, 304	3, 860	7, 524	21, 570	953. 332	951	246	4. 07
Fayette	5, 431, 199	1, 583, 129	531, 328	3, 592, 499	543, 660	11, 681, 815	170, 960	92, 489	[16] 429, 265	12, 431, 874	13, 092	224	4. 25
Gilmer				15, 529		15, 529	4, 078	306		19, 913	71	108	2. 60
Grant							18, 896			18, 896	51	152	2. 44
Greenbrier	901, 075	116, 291		550, 337	194, 798	1, 762, 501	26, 735	9, 269	169	1, 794, 947	1, 899	196	4. 83
Hancock							86, 036		945	86, 981	161	225	2. 40
Harrison	83, 222	528, 299		1, 185, 184	2, 099, 229	3, 895, 934	90, 844	6, 867	3, 779	4, 000, 926	3, 441	175	6. 65
Kanawha	114, 059	1, 290, 809	1, 726, 753	3, 126, 141	584, 968	6, 842, 730	61, 116	49, 735	5, 547	7, 033, 250	7, 465	213	4. 43
Lewis							14, 986			14, 986	25	202	2. 97
Logan	1, 280, 895	3, 691, 344	1, 592, 480	6, 328, 250	2, 497, 854	15, 390, 823	16, 623	106, 540	6, 128	15, 509, 835	12, 713	200	6. 11
McDowell	4, 592, 689	4, 510, 810		12, 452, 627	267, 359	21, 823, 485	38, 647	142, 584	[16] 200, 056	22, 345, 986	20, 949	213	5. 01
Marion	482, 807	1, 008, 026		5, 568, 264	1, 369, 734	8, 428, 831	235, 127	17, 608	40, 467	8, 706, 653	7, 154	202	6. 03
Marshall		20, 212	237, 156	61, 174	217, 193	535, 735	94, 045		144	629, 920	757	164	5. 07
Mason			1, 260	3, 317		4, 577	70, 325	752	3, 500	82, 083	177	145	3. 20
Mercer	1, 069, 536	766, 718		1, 623, 514	64, 709	3, 524, 477	5, 167	28, 761	1, 161	3, 560, 502	4, 062	210	4. 17
Mineral				182, 446	42, 794	225, 240	46, 345	2, 296	1, 666	276, 833	530	201	2. 60
Mingo	71, 778	713, 342		1, 824, 432	1, 313, 070	3, 922, 622	12, 037	24, 476	258	3, 965, 374	3, 694	206	5. 20
Monongalia	17, 251	542, 455	427, 242	3, 082, 596	2, 230, 296	6, 299, 840	47, 863	10, 464	233	6, 370, 374	4, 472	207	6. 87
Nicholas	542			9, 533	49	10, 124	24, 610		3, 023	37, 737	86	165	2. 67
Ohio		395, 656	479, 311	461, 249	488, 362	1, 824, 578	231, 516	54	305	2, 058, 418	2, 060	241	4. 14
Preston	46, 058			353, 530	92, 219	491, 807	30, 820	1, 441	[16] 77, 741	602, 036	1, 039	150	3. 87
Putnam			392, 659	21, 415	63, 988	478, 062	38, 156	2, 439	15, 776	504, 826	687	204	3. 60
Raleigh	4, 384, 574	1, 987, 810		8, 233, 168	152, 004	14, 757, 556	39, 317	130, 818	67, 777	14, 997, 631	14, 691	221	4. 63
Randolph	229, 242	119, 625		473, 431	47, 012	869, 310	47, 564	3, 197	20, 389	941, 850	1, 116	180	4. 69
Taylor	17, 815			110, 026	489, 469	617, 310	23, 463	886		641, 659	869	158	4. 66
Tucker	194, 275			234, 263	51, 049	479, 587	6, 121	2, 845	18, 519	512, 494	646	182	4. 36
Upshur	6, 996			34, 082	126, 272	167, 350	12, 236	423	3, 845	183, 854	289	119	5. 36
Wayne		4, 491		5, 750	4, 768	15, 009	11, 872			26, 881	122	78	2. 83
Webster	149, 406			615, 187	62, 859	827, 452	5, 300	2, 231	1, 089	836, 072	1, 100	177	4. 30
Wyoming	764, 627	326, 861		1, 510, 368	8, 372	2, 610, 228	9, 754	12, 599	21, 549	2, 638, 299	2, 574	243	4. 21
Total West Virginia	19, 919, 591	18, 628, 479	5, 421, 922	55, 006, 125	15, 251, 387	114, 227, 504	2, 531, 248	686, 753	[16] 948, 899	118, 646, 343	113, 643	209	5. 00

See footnotes at end of table.

TABLE 39.—*Production, men employed, days operated, and output per man per day at bituminous-coal mines in specified States and counties in 1937*—Continued

WYOMING

County	Distribution of product—net tons										Average number of employees	Average number of days mines operated	Average tons per man per day
	Loaded at mines for shipment by rail and water						Truck deliveries including local sales	Used by mine employees	Mine fuel or made into beehive coke at mines	Total production, including inventory change and coal unaccounted for[3]			
	To tidewater	To Great Lakes	River and ex-river	All-rail other than railroad fuel[1]	Railroad fuel all-rail[2]	Total							
Campbell				61,836	27,763	89,599	17,387	639	6,722	114,347	42	247	11.00
Carbon				87,505	502,454	589,959	33,344	3,766	19,785	646,854	367	235	7.50
Converse							10,883			10,883	13	280	2.99
Fremont				22,757	6,119	28,876	11,421	206	4,970	45,473	49	119	7.82
Hot Springs				171,841	16,948	188,789	15,395	2,073	24,091	230,786	380	186	3.27
Johnson					2,076	2,076	7,301	138	450	10,170	11	232	3.98
Lincoln				178,608	317,583	496,191	44,463	4,196	11,179	558,362	601	209	4.44
Sheridan				256,203	321,485	577,688	65,352	3,519	2,365	649,643	356	146	12.49
Sweetwater				543,489	3,005,381	3,548,870	6,071	21,587	55,992	3,632,566	2,893	209	6.00
Other counties (Big Horn, Natrona, and Uinta)				3,491	4,691	8,182	10,927	166		19,275	31	217	2.86
Total Wyoming				1,325,730	4,204,500	5,530,230	222,544	36,290	[4] 125,554	5,918,359	4,743	204	[7] 6.11

1 Includes coal reported as "shipped to distributors, destinations unknown," a small part of which may have been forwarded to tidewater or Great Lakes.
2 Includes coal taken by locomotives at tipple.
3 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.
4 No coal was made into beehive coke at mines in 1937.
5 Includes 115,278 tons made into beehive coke at mines in Las Animas County in 1937 (93,941 tons in 1936).
6 "Other counties" include, Adams, Bond, Brown, Crawford, Hancock, Logan, Macon, Marion, Putnam, Scott, Warren, White, and Will.
7 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.
8 Production of Home Riverside and Alston mines is credited to Missouri rather than to Kansas.
9 The output is chiefly obtained from strip pits, in which the production per man per day is large.
10 Data on lignite compiled by L. Mann, Bureau of Mines; see Lignite Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
11 Includes coal made into beehive coke at mines in the following counties in 1937: Bedford, 63,805; Blair, 2,732; Cambria, 67,083; Fayette, 2,753,684; Indiana, 302,980; Westmoreland, 596,818. The State total is 3,787,102 tons in 1937 against 1,907,101 tons in 1936. Does not include coal shipped in by rail or truck from mines to beehive ovens for coking, such tonnage being included under rail or truck deliveries.
12 Includes 25,645 tons made into beehive coke at mines in Grundy County and 915 tons in Morgan County in 1937, compared with 6,886 tons in Grundy County in 1936.
13 Includes 12,271 tons made into beehive coke at mines in Carbon County in 1937 (9,754 tons in 1936).
14 Figures compiled by L. Mann, Bureau of Mines; see Anthracite and Semianthracite Outside of Pennsylvania Tables, 1937. "Loaded at mines for shipment," as published by Bureau of Mines, included under "all-rail"; "commercial sales by truck or wagon" and "other sales to local trade, etc.," as published by Bureau of Mines, included under "truck deliveries including local sales."
15 Includes 412,192 tons made into beehive coke at mines in Wise County in 1937 (330,130 tons in 1936).
16 Includes 530,651 tons made into beehive coke at mines in Fayette and Preston Counties, and briquets in McDowell County; figures for individual counties cannot be disclosed.

PRODUCTION AND CONSUMPTION IN ALASKA

TABLE 40.—*Coal produced and consumed in Alaska, 1933–37*

Year	Produced in Alaska, chiefly subbituminous coal and lignite [1]		Imported from States, chiefly bituminous coal from Washington [2] (net tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia [2] (net tons)	Total coal consumed (net tons)
	Net tons	Value			
1933	96,467	$481,000	21,524	14,009	132,000
1934	107,508	451,000	28,317	14,675	150,500
1935	119,425	502,000	26,554	15,707	161,686
1936	136,593	574,000	27,643	11,806	176,042
1937	131,657	553,000	[3] 24,562	[3] 10,781	[3] 167,000

[1] Alaskan Branch of the Geological Survey.
[2] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[3] Revised figures.

STATISTICS OF LIGNITE AND HARD COAL OUTSIDE OF PENNSYLVANIA

In statistics of the Bureau of Mines the anthracite industry of Pennsylvania and the bituminous-coal industry are shown separately.

Following general trade usage, the statistics of the bituminous-coal industry, as given in this and previous reports, include lignite and the small quantities of anthracite and semianthracite produced outside of Pennsylvania. Due, however, to the geographical location of the three principal lignite fields and to the inherent characteristics of hard coal, these coals have been deemed important enough to be treated in separate tables in previous issues of the Minerals Yearbook. To maintain the continuity of this supplementary series, the classification of producers heretofore used has been retained in tables 41 and 42 without reference to final determination of their status under section 17 (b) of the Bituminous Coal Act of 1937.

Preliminary estimates for 1938 indicate an output of 3,008,000 tons of lignite compared with 3,218,419 tons in 1937 and 3,109,689 in 1936. Summary statistics, by States, for 1937 are given in table 41.[6]

The production of hard coal outside of Pennsylvania during 1938 is estimated at 369,000 tons. Comparative tonnages for 1937 and 1936 were 468,852 and 520,452, respectively. Detailed data by States are presented in table 42.

[6] Tables 41 and 42 were compiled by L. Mann, Coal Economics Division, Bureau of Mines. Detailed statistics for these items were published in mimeographed form by the Bureau of Mines as follows: Lignite, January 17, 1939; anthracite and semianthracite outside of Pennsylvania, November 5, 1938. Copies of these tables are available for free distribution upon request.

TABLE 41.—*Production, value, men employed, days mines operated, and output per man per day at lignite mines in 1937*

[Includes all coal produced in the areas mapped as "lignite" in Geological Survey Professional Paper 100-A, The Coal Fields of the United States. Note that subbituminous coal, sometimes known as "black lignite," is not included]

	North Dakota	South Dakota	Montana [1]	Texas	Total
Production (net tons):					
Loaded at mines for shipment	1,577,216	26,444	4,000	830,042	2,437,702
Commercial sales by truck or wagon	470,778	20,426	49,299	28,763	569,266
Other sales to local trade or used by employees, or taken by locomotives at tipple	193,033	104	910	1,553	195,600
Used at mines for power and heat	9,810	5	102	5,934	15,851
Total production	2,250,837	46,979	54,311	866,292	3,218,419
Value:					
Total	$2,639,000	$63,000	$92,000	$683,000	$3,477,000
Average per ton	$1.17	$1.34	$1.69	$0.79	$1.08
Number of employees:					
Underground	689	18	63	469	1,239
Surface (including strip pits)	786	29	18	58	891
Total employees	1,475	47	81	527	2,130
Average number of days mines operated	181	165	167	218	189
Average tons per man per day	8.41	6.05	4.00	7.56	7.98
Produced by stripping (net tons)	1,347,355	42,094	[2] 88,574	(2)	1,478,023

1 Custer, Daniels, Dawson, Richland, Roosevelt, Sheridan, Valley, and Wibaux Counties.
2 Montana includes Texas.

TABLE 42.—*Production, value, men employed, days mines operated, and output per man per day at the principal hard-coal mines outside of Pennsylvania in 1937*

[Includes coal classified as anthracite and semianthracite in Geological Survey Professional Paper 100-A, The Coal Fields of the United States]

	Arkansas	Colorado and New Mexico	Virginia	Total
Production (net tons):				
Loaded at mines for shipment	211,193	44,082	163,604	418,879
Commercial sales by truck or wagon	5,005	333	28,320	33,658
Other sales to local trade, or used by employees, or taken by locomotives at tipple	391	84	3,853	4,328
Used at mines for power and heat	2,564	1,067	8,356	11,987
Total production	219,153	45,566	204,133	468,852
Value:				
Total	$693,000	$190,000	$539,000	$1,422,000
Average per ton	$3.16	$4.17	$2.64	$3.03
Number of employees:				
Underground	756	120	436	1,312
Surface	165	45	141	351
Total employees	921	165	577	1,663
Average number of days mines operated	96	287	183	145
Average tons per man per day	2.49	0.96	1.93	1.94

PENNSYLVANIA ANTHRACITE

By M. van Siclen, L. Mann, and J. R. Bradley

SUMMARY OUTLINE

Pressure from competitive fuels and a year of abnormally high temperatures combined to lessen the demand for anthracite, and total production fell from 51,856,000 net tons in 1937 to 46,099,000 in 1938, or 11 percent, thus receding to a point below the depression years of 1932 and 1933. This compares with a drop of 23 percent in the production of bituminous coal. The corresponding figures for commercial shipments were 46,203,000 tons in 1937 and 41,064,000 in 1938. The figures are exclusive of the output of unauthorized mines, which was closely estimated by the Pennsylvania Department of Mines at 2,500,000 net tons in 1938. This activity is concentrated largely in the Southern and Western fields. The industrial recession in 1938 had little effect on consumption of anthracite, which is primarily a fuel for domestic heating.

Prices at the mine for both domestic and steam sizes were slightly higher in 1938 than in 1937, and wholesale prices for coal on tracks at destination were about the same. Shippers to the larger markets, especially New York, were afflicted by price cutting among the producing interests on so-called distress coal, despite attempts at stabilization. As indicated by operating reports, the average of mine costs was affected adversely by the smaller production and by sporadic suspensions of work unauthorized by the labor union. Taxes remained high, and freight rates increased slightly during the year.

Withdrawal of the Canadian import duty was not achieved when the trade agreement with Canada was made, but the Canadian excise tax was removed on April 26, 1939.

New and revised State laws covering occupational diseases and workmen's compensation went into effect on January 1, 1938, which, if accepted, would greatly increase mining-company costs. However, many of the companies rejected the revised compensation act as permitted under the law.

More encouraging were the widening effect of educational and testing work done by Anthracite Industries, Inc., and the representation of the industry by the Anthracite Institute at all public and trade matters of interest, as well as their prompt publication of trade statistics.

Provisions against the sale of illegally mined anthracite were enforced by adjoining States to the extent of funds available, and this trade became restricted more and more to Pennsylvania.

The faith of local chambers of commerce and of the people of the region generally in the future of their principal industry was shown by the raising of funds for a generous anthracite display at the New York World's Fair of 1939. The fundamental factors underlying the industry—the character of anthracite and its geographic location near thickly populated industrial centers requiring both heat and power—remain permanent and favorable.

No general legislation dealing with stabilization of the anthracite industry was passed during the year by either the State or the Federal Government.

Statistical trends in the industry for 1938 are shown in the following tables:

TABLE 1.—*Statistical trends of the Pennsylvania anthracite industry, 1934–38*

	1934	1935	1936	1937	1938
Production:					
Loaded at mines for shipment:					
Breakers.........net tons..	49,435,764	44,369,285	46,256,132	44,016,915	39,010,935
Washeries.........do....	966,804	1,794,402	2,066,973	1,837,879	1,379,509
Dredges.........do....	353,754	374,142	324,895	348,350	373,425
Sold to local trade and used by employees.........net tons..	3,285,936	2,874,970	3,226,887	2,981,391	2,722,206
Used at collieries for power and heat net tons..	3,126,033	2,745,984	2,704,648	2,671,898	2,312,952
Total production.........do....	57,168,291	52,158,783	54,579,535	51,856,433	46,099,027
Value at breaker, washery, or dredge......	$244,152,000	$210,131,000	$227,004,000	$197,599,000	$180,600,167
Average sales realization per net ton on breaker shipments:					
Lump and broken.........	$5.43	$5.16	$5.05	$5.08	$5.24
Egg.........	$5.88	$5.44	$5.60	$5.06	$5.18
Stove.........	$6.23	$5.87	$6.09	$5.21	$5.33
Chestnut.........	$5.98	$5.64	$5.91	$5.23	$5.36
Pea.........	$4.40	$4.16	$4.30	$4.01	$3.88
Total domestic.........	$5.80	$5.45	$5.67	$5.01	$5.10
Buckwheat No. 1.........	$2.86	$2.88	$2.91	$2.95	$3.03
Buckwheat No. 2 (Rice).........	$1.56	$1.74	$2.01	$2.26	$2.35
Buckwheat No. 3 (Barley).........	$.97	$1.08	$1.23	$1.45	$1.61
Boiler.........	$1.25	----------	----------	$.78	----------
Other, including Buckwheat No. 4....	$.71	$.57	$.68	$.79	$.87
Total steam.........	$1.98	$2.03	$2.10	$2.21	$2.33
Total, all sizes.........	$4.53	$4.29	$4.42	$4.03	$4.16
Percentage by sizes in total breaker shipments:					
Lump and broken.........percent..	0.3	0.3	0.3	0.4	0.3
Egg.........do....	7.9	7.0	6.5	5.7	5.4
Stove.........do....	22.4	21.8	21.3	22.1	23.7
Chestnut.........do....	25.5	26.1	26.4	26.2	26.0
Pea.........do....	10.6	10.7	10.4	10.8	10.6
Total domestic.........do....	66.7	65.9	64.9	65.2	66.0
Buckwheat No. 1.........do....	15.3	15.1	15.1	14.7	14.8
Buckwheat No. 2 (Rice).........do....	8.6	9.3	8.4	7.9	7.7
Buckwheat No. 3 (Barley).........do....	7.6	7.8	8.8	8.9	8.6
Boiler.........do....	(1)	----------	----------	(1)	----------
Other, including Buckwheat No. 4 percent..	1.8	1.9	2.8	3.3	2.9
Total steam.........do....	33.3	34.1	35.1	34.8	34.0
Producers' stocks on Dec. 31 [2]...net tons..	1,921,000	1,911,000	2,259,000	2,154,000	1,458,000
Exports.........do....	1,298,000	1,609,000	1,678,000	1,914,000	1,909,000
Imports.........do....	478,000	571,000	615,000	396,000	363,000
Consumption (calculated).........do....	55,500,000	51,100,000	53,200,000	50,400,000	45,200,000
Capacity in operation (calculated)..do....	84,000,000	84,000,000	87,000,000	83,000,000	(3)
Average number of days worked.........	207	189	192	189	(3)
Man-days lost on account of strikes and lock-outs.........	774,856	763,307	407,372	580,462	(3)
Number of men on strike during year......	38,994	26,127	27,574	34,346	(3)
Average number of men employed.........	109,050	103,269	102,081	99,085	[4] 97,000
Output per man per day.........net tons..	2.53	2.68	2.79	2.77	(3)
Output per man per year.........do....	524	505	535	523	(3)
Quantity cut by machines.........do....	1,981,088	1,848,095	2,162,744	1,984,512	1,588,407
Quantity mined by stripping.........do....	5,798,138	5,187,072	6,203,267	5,696,018	5,095,341
Quantity loaded by machines underground net tons..	9,284,486	9,279,057	10,827,946	10,683,837	10,151,669
Distribution:					
Total receipts in New England [5] net tons..	5,972,000	5,402,000	5,287,000	4,761,000	4,468,000
Exports to Canada.........do....	1,266,000	1,592,000	1,664,000	1,893,000	1,896,000
Loaded into vessels at Lake Erie [6] net tons..	607,000	559,000	689,000	674,000	450,000
Receipts at Duluth-Superior [7]...do....	229,000	182,000	309,000	296,000	155,000

[1] Less than 0.1 percent.
[2] Anthracite Institute. Figures represent prepared coal on the ground at the breaker.
[3] Data not yet available.
[4] Estimated from the report of the Pennsylvania Department of Mines; Bureau of Mines data not yet available.
[5] Commonwealth of Massachusetts, Division on the Necessaries of Life.
[6] Ore and Coal Exchange.
[7] U. S. Engineer Office, Duluth, Minn.

TABLE 2.—*Statistical summary of monthly developments in the Pennsylvania anthracite industry in 1938*

[All tonnage figures represent net tons]

	1938													Change from preceding year, percent	1937 (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	4,978,000	3,646,000	4,257,000	3,149,000	4,400,000	4,450,000	2,580,000	2,735,000	3,388,000	4,180,000	3,803,000	4,533,000	46,099,000	−11.1	51,856,000
Average per working day	199,100	155,100	157,700	126,000	176,000	171,200	103,200	101,300	135,500	167,200	158,500	174,300	151,900	−11.1	170,900
Shipments, breakers, and washeries only:[1] Monthly total, all sizes	4,421,519	3,056,728	3,467,048	2,892,822	3,821,416	3,868,567	2,360,764	2,336,498	2,887,972	3,518,678	3,167,348	3,848,666	39,648,026	−11.9	45,024,369
Distribution:															
Lake Erie loadings[2]				35,858	55,615	88,490	86,913	53,370	35,759	70,531	23,677	111	450,324	−33.2	673,768
Receipts at Duluth-Superior[3]					13,888	51,861	33,620	17,340	9,242	19,337	10,174		155,462	−47.5	296,003
Upper Lake dock trade:[4]															
Receipts:															
Lake Superior					18,064	60,663	33,632	17,345	9,244	28,663	10,177		177,788	−43.3	313,527
Lake Michigan	807	618	1,806	24,490	34,196	32,178	58,106	43,265	10,761	44,524	24,098	509	275,358	−15.9	327.489
Deliveries (reloadings):															
Lake Superior	24,053	14,045	4,213	6,199	27,675	19,270	11,156	9,333	16,179	25,242	31,553	22,027	210,945	−26.8	288,057
Lake Michigan	29,484	23,257	13,547	10,895	29,988	49,963	35,624	14,157	20,475	20,207	22,158	22,968	292,723	−11.3	329,999
Retail yards—216 selected dealers:[4] Deliveries	461,386	383,870	352,421	230,279	222,885	256,626	260,261	240,910	304,639	266,659	275,650	383,249	3,638,835		(5)
New England receipts:[6]															
By tide (including imports)	73,033	79,856	58,776	89,811	131,827	128,390	57,876	69,045	55,140	63,249	95,402	74,765	977,170	−6.7	1,047,865
By rail	392,019	278,957	256,511	260,981	332,834	311,792	214,458	222,851	209,902	352,404	269,009	388,982	3,490,700	−6.0	3,712,734
Exports[7]	189,433	143,139	135,594	120,278	248,688	220,390	125,876	111,748	144,890	166,723	142,310	159,842	1,908,911	−.3	1,914,173
Imports[7]	23,698	41,464	19,584	32,174	42,306	36,758	17,938	20,419	28,444	20,478	48,430	31,202	362,895	−8.3	395,737
Industrial consumption by:															
Railroads (class I only)[8]	154,411	136,836	140,306	110,130	107,632	90,750	95,325	94,674	93,690	115,754	124,230	142,507	1,406,245	−5.5	1,488,802
Electric-power utilities[9]	160,260	127,528	145,230	144,780	162,803	163,217	161,452	174,976	173,183	184.913	174,413	198,955	1,971,710	+4.1	1,894,650
Other industrial consumers[10]	126,498	120,631	120,234	96,365	77,706	67,993	85,191	92,410	99,450	91.757	97,855	86,776	1,162,866	−10.0	1,291,835

Stocks at end of period shown:															
Railroads (class I only) [8]	261,375	229,468	203,281	186,367	181,952	198,627	179,167	168,470	160,916	147,231	127,980	114,078	114,078	−58.4	273,925
Electric-power utilities [9]	1,412,461	1,433,259	1,411,046	1,397,645	1,389,624	1,411,215	1,387,587	1,327,274	1,302,934	1,283,474	1,263,396	1,210,768	1,210,768	−16.1	1,442,333
Other industrial consumers [10]	254,805	262,296	248,815	214,717	199,473	215,584	260,875	255,496	245,911	224,361	266,329	212,790	212,790	−11.7	240,889
Stocks on Upper Lake docks: [4]															
Lake Superior	160,290	146,242	142,023	135,820	125,664	167,054	189,526	197,597	190,588	194,007	171,373	149,343	149,343	−19.0	184,349
Lake Michigan	140,598	117,958	106,217	119,758	123,966	106,181	128,663	157,772	148,058	172,332	174,272	151,813	151,813	−10.3	169,277
Retail stocks from 216 selected dealers [4]	433,578	334,695	277,275	340,025	423,779	486,908	514,661	525,688	469,703	542,402	491,206	462,972	462,972	−6.2	493,471
Producers' stocks [1]	1,652,021	1,410,846	1,263,600	1,270,964	1,387,948	1,756,713	1,757,492	1,924,422	2,120,835	1,916,538	1,900,762	1,457,533	1,457,533	−32.3	2,154,429
Prices at mines, average per net ton: [11]															
Company stove	$6.25	$6.25	$6.25	$5.75	$5.50	$5.56	$5.82	$6.10	$6.25	$6.25	$6.40	$6.40	$6.07	+1.5	$5.98
Company buckwheat No. 1	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	$3.50	+4.2	$3.36
Wholesale prices: [12]															
On tracks, destination:															
Chestnut	$9.68	$9.63	$9.56	$9.20	$8.95	$9.03	$9.23	$9.43	$9.60	$9.61	$9.71	$9.71	$9.45	+.9	$9.37
Pea	$8.35	$8.33	$8.27	$7.88	$7.63	$7.71	$7.90	$8.10	$8.17	$8.17	$8.27	$8.29	$8.09	−.7	$8.15
Index numbers (1926=100)	80.1	79.8	79.3	76.0	73.8	74.5	76.2	77.9	79.1	79.1	80.1	80.1	78.0	+.3	77.8
Labor conditions: [12]															
Average weekly earnings	$25.27	$24.86	$26.01	$22.26	$23.61	$28.94	$14.76	$17.35	$20.64	$26.99	$23.14	$26.99	$23.40	−7.1	$25.19
Index of employment (1929 average=100)	59.6	60.0	59.3	57.0	52.8	56.0	44.6	37.6	46.4	52.4	51.0	51.3	52.3	−13.1	60.2
Index of pay-roll totals (1929 average=100)	46.5	46.1	47.3	39.0	38.3	49.7	20.2	20.0	29.4	43.4	36.2	42.5	38.2	−18.6	46.9

1 Anthracite Institute.
2 Ore and Coal Exchange, Cleveland, Ohio.
3 U. S. Engineer Office, Duluth, Minn.
4 National Bituminous Coal Commission.
5 Data not available.
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 Computed from weekly quotations of trade journals. Figures represent circular prices on white ash coal by leading anthracite producing interests.
12 Bureau of Labor Statistics.

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 41 and 42 of the chapter on Bituminous Coal in this volume record the 1937 production of anthracite and semianthracite outside of Pennsylvania; data for 1938 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 officially classified as semianthracite.

Weather.—As anthracite is essentially a household fuel the weather has an important bearing on the demand. Mild weather in the spring of 1938 and again in the late fall adversely affected the anthracite market.

The year 1938 was much warmer and slightly wetter than normal. The New England States and New York are important anthracite markets. In the New England States monthly departures from normal temperatures were January −1.3°, February +3.4°, March +1.9°, April +2.6°, October +3.0°, November +2.6°, and December +2.1°. In New York temperature deviations from normal were January −0.9°, February +5.1°, March +4.9°, April +2.4°, October −0.4°, November +2.9°, and December −0.5°. Thus, in New England during the 7 coal-burning months only 1 month was below normal and in New York only 3 months.[1]

It is thus evident that the above-normal temperatures of the leading consuming centers were responsible for a marked drop in demand for anthracite.

Competitive fuels.—The principal markets for Pennsylvania anthracite are the New England States, New York, New Jersey, Delaware, Maryland, Pennsylvania, and the District of Columbia, which took 84.2 percent of the production of anthracite in 1936 and 80.2 percent in 1937. Of the mineral fuels available for use in these States (excluding the important item of bituminous coal, for which no data are available, and natural and liquefied gases), the share contributed by anthracite continued to decline, as did the total apparent consumption of all fuels. Consumption of anthracite, briquets, coke, and fuel oils (in terms of coal) was equivalent to 71,706,000 tons in 1936 and declined 3.4 percent to 69,293,000 tons in 1937. Comparable data for 1938 are not yet available. Of the total fuels in 1936 and 1937, respectively, Pennsylvania anthracite comprised 64.1 and 60 percent; imported anthracite, 0.9 and 0.6 percent; briquets, 0.2 and 0.1 percent; coke for domestic use, 7.0 and 5.8 percent; imported coke, 0.3 and 0.2 percent; and heating and range oils, 27.5 and 33.3 percent. In 1937 the coal equivalent of heating and range oils available for use was more than half the tonnage of anthracite. The losses in anthracite consumption were balanced by gains in the use of heating and range oils, which increased 17 percent over 1936. Details are shown in table 3.

[1] Monthly Weather Review for January 1939, p. 16.

TABLE 3.—*Apparent consumption of anthracite and selected competitive fuels in the principal anthracite markets, 1936–37* [1]

[Thousands of net tons]

Fuel	New England	New York	New Jersey	Delaware	Maryland	Pennsylvania	District of Columbia	Total: Quantity	Total: Percent
1936									
Anthracite:									
All uses [2]	4,479	[3] 18,217	[3] 8,482	250	713	13,478	348	45,967	64.1
Imports [4]	612	1						613	.9
Briquets:									
Domestic use	60	57	3	1	4	21	1	147	.2
Imports [4]	20							20	
Coke:									
Domestic use	1,420	2,234	550	7	9	783	2	5,005	7.0
Imports [4]	83	120						203	.3
Oil: Heating and range [5]	8,003	6,370	2,731	87	477	1,740	343	19,751	27.5
	14,677	26,999	11,766	345	1,203	16,022	694	71,706	100.0
1937									
Anthracite:									
All uses [2]	4,129	[3] 16,695	[3] 7,796	238	655	11,777	296	41,586	60.0
Imports [4]	395							395	.6
Briquets:									
Domestic use	40	36	2		2	14	1	95	.1
Imports [4]	7							7	
Coke:									
Domestic use [6]	1,144	1,800	443	6	7	631	2	4,033	5.8
Imports [4]	43	77						120	.2
Oil: Heating and range [5]	9,358	7,457	3,179	110	578	1,985	390	23,057	33.3
	15,116	26,065	11,420	354	1,242	14,407	689	69,293	100.0

[1] Figures for 1938 not yet available.
[2] Pennsylvania Department of Mines.
[3] An important but undetermined part of anthracite shown as shipped to New Jersey is reshipped to New York City.
[4] Bureau of Foreign and Domestic Commerce.
[5] Converted to coal equivalent on the basis of 4 barrels of fuel oil equaling 1 ton of coal.
[6] Estimated on the basis of distribution in 1936.

Sales of coke for domestic heating, fuel briquets and packaged fuel, manufactured gas for domestic use and for house heating, and natural gas for all purposes for the most part either declined or increased only moderately in 1938. Noteworthy exceptions were the increases of 19.5 percent in sales of manufactured gas for house heating in New Jersey and of 17 percent in New York. Sales of range oil and heating oils rose considerably in 1938, and sales of liquefied petroleum gases increased 42 percent over 1937. Detailed figures are shown in table 4.

The general slackening in 1938 was reflected not only in the consumption of fuels but also in the shipment of mechanical coal stokers, oil burners, and distillate oil burners. The sole exception was a 38-percent increase in factory sales of anthracite-burning types of stokers—from 9,074 units in 1937 to 12,561 in 1938.

In addition to the competition of other fuels, an invisible factor tending to decrease consumption is the more efficient combustion of anthracite, which, however, is probably less than that achieved in the technology of bituminous coal. Other factors tending to decrease consumption are the wider use of insulation in house construction, improved radiation systems, the relative increase in two-family and apartment dwellings, and the uniformly high grade of prepared sizes of anthracite which contain more heat units per ton.

TABLE 4.—*Total supplies of fuels commonly used for domestic purposes in the United States, 1924 and 1935–38*

[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	1935	1936	1937	1938
SOLID FUELS (NET TONS)					
Pennsylvania anthracite:					
Production:					
Shipments of domestic sizes	56, 576, 296	29, 653, 652	30, 472, 986	29, 092, 974	26, 206, 508
Shipments of Buckwheat No. 1 [1]	9, 510, 508	7, 211, 952	7, 507, 767	6, 859, 707	6, 159, 006
Shipments of smaller steam sizes	11, 160, 695	9, 672, 225	10, 667, 247	10, 250, 463	8, 698, 355
Local sales	3, 043, 939	2, 874, 970	3, 226, 887	2, 981, 391	2, 722, 206
Total commercial production	80, 291, 438	49, 412, 799	51, 874, 887	49, 184, 535	43, 786, 075
Exports	4, 017, 785	1, 608, 549	1, 678, 024	1, 914, 173	1, 908, 911
Imports for consumption (chiefly from United Kingdom and U. S. S. R.)	117, 951	571, 439	614, 639	395, 737	362, 895
Fuel briquets: Calculated consumption [2]	580, 508	877, 486	1, 113, 551	977, 254	868, 382
Packaged fuel production		25, 244	66, 427	146, 037	160, 952
Coke:					
Byproduct sales for domestic use	2, 812, 771	9, 161, 980	9, 643, 507	7, 807, 792	[3] 7, 100, 000
Beehive sales for domestic use	139, 886	264, 406	377, 836	299, 726	93, 306
Imports for consumption	82, 833	317, 379	329, 959	286, 364	135, 240
Gas-house-coke sales [4]	1, 400, 000	466, 000	403, 600	350, 700	342, 300
Petroleum-coke production	761, 100	1, 458, 000	1, 378, 200	1, 306, 600	1, 602, 200
Anthracite and semianthracite production outside of Pennsylvania	704, 513	423, 090	520, 452	468, 852	[3] 369, 000
Lignite production [5]	2, 255, 385	2, 750, 179	3, 109, 689	3, 218, 419	[3] 3, 008, 000
Bituminous-coal sales for domestic use	(6)	(6)	(6)	(6)	(6)
OIL (BARRELS OF 42 GALLONS)					
Oil sales for heating buildings:					
Range oil [7]	(8)	21, 526, 000	27, 292, 000	32, 580, 000	[3] 36, 000, 000
Heating oils: [9]					
Domestic	5, 021, 000	76, 853, 000 (Domestic and Commercial)	99, 257, 000	116, 583, 000	[3] 118, 000, 000
Commercial	(8)				
Liquefied petroleum gases, domestic	(8)	509, 000	714, 600	972, 000	1, 377, 000
GAS (MILLION CUBIC FEET)					
Natural gas consumption for domestic and commercial use [10]	285, 152	413, 685	454, 969	489, 234	[3] 476, 000
Manufactured gas sales for: [11]					
Domestic use	(8)	206, 636	198, 199	194, 350	197, 261
House heating	(8)	35, 040	41, 226	45, 525	47, 918

1 A considerable part of the Buckwheat No. 1 is used for domestic purposes.
2 Production plus imports less exports where available.
3 Subject to revision.
4 Partly estimated.
5 An estimated two-thirds is used for domestic purposes.
6 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.
7 Range oil is a light distillate used for house heating, hot-water heating, and cooking.
8 Data not available.
9 Includes all grades of fuel oil used for heating buildings.
10 Includes gas used for heating offices, hotels, apartments, schools, hospitals, and stores and other large buildings, as well as houses.
11 American Gas Association. Data revised as of March 1939.

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 45,200,000 net tons in 1938, a decrease of 10 percent compared with 1937. Sales of illicit coal have not been considered in either year.

Consumption of anthracite by railroads in 1938 ranged from a high of 154,411 tons in January to a low of 90,750 tons in June, and the total for the year was 5.5 percent less than in 1937. Consumption by electric-power utilities ranged from 127,528 to 198,955 tons a month and was 4.1 percent above 1937. Other industrial consumption declined 10 percent. Total industrial consumption was about 135,000 tons less than in 1937.

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 1937–38 (2,483,000 tons) was virtually the same as in 1936–37, and that of buckwheat (192,000 tons) increased 8 percent.

Imports of foreign anthracite into the New England States in 1938 (363,000 net tons) comprised 8 percent of the total receipts of anthracite into that region.

Nonfuel uses.—The Anthracite Institute reports that in 1938, according to replies received from companies producing 68 percent of the commercial output, more than 216,000 tons of anthracite, mostly Buckwheat No. 4 and smaller, were sold for nonfuel uses. The greatest nonfuel uses for anthracite were as follows: Reducing zinc, for which 123,000 tons were used; sintering iron ores, which required 45,000 tons; and carbonizing steel, for which 30,700 tons were used. The sale of anthrafilt continued to increase.

Method of transport.—There was a drastic decline in rail shipments of Pennsylvania anthracite from 1936 to 1938. Shipments by rail to the three principal markets—New York, Pennsylvania, and New Jersey—comprised 83.2 percent of total shipments in 1936, 82.6 percent in 1937, and 82 percent in 1938. However, while the percentage shipped to these markets remained almost the same the quantity dropped from 37,067,743 tons in 1936 to 32,719,986 in 1937 and 26,222,562 in 1938, an over-all decline of 29 percent. During 1938 no foreign coal was imported into these three States. Shipments to Canada fluctuated slightly but held up better during the 3-year period than did those to the domestic market.

Both the tonnage and the method of transporting anthracite to the New England States have varied considerably in the past decade. New England receipts of anthracite of domestic origin totaled 8,556,979 net tons, of which 79 percent was transported by rail, in 1929; 4,809,492 net tons, of which 74 percent was transported by rail, in 1933; and 4,105,004 net tons, of which 85 percent arrived by rail, in 1938. Receipts of anthracite at tidewater in the New England States in 1938, including imports, were 977,170 tons, a decrease of 6.7 percent compared with 1937, and receipts by rail were 3,490,700 tons, a decline of 6 percent.[2]

Loadings at Lake Erie ports dropped 33.2 percent, and receipts at Duluth-Superior were 47.5 percent less than in 1937. Shipments off Lake docks also decreased—at Lake Superior 26.8 percent and at Lake Michigan 11.3 percent.

In March 1938 the Pennsylvania Public Utilities Commission reduced the freight rates to a number of points within the State of Pennsylvania. In the same month a small increase in the rates on interstate shipments of anthracite was allowed by the Interstate Commerce Commission. This increase was extended late in 1938 by the Interstate Commerce Commission to cover intrastate shipments. The so-called motor-compelled freight rates again were extended.

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[2] Commonwealth of Massachusetts, Division on the Necessaries of Life.

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Details covering distribution of shipments of Pennsylvania anthracite by rail (truck shipments excluded) for 1936–38 are shown in table 5.

TABLE 5.—*Shipments of Pennsylvania anthracite, 1936–38, by States of destination, in net tons* [1]

[Truck shipments excluded]

	1936	1937	1938
New England States	4,478,509	4,128,408	3,551,572
New York	17,815,434	16,388,675	13,214,996
New Jersey	8,186,524	7,533,475	6,180,129
Pennsylvania	11,065,785	8,797,836	6,827,437
Delaware	238,121	213,493	168,316
Maryland	673,461	614,218	545,454
District of Columbia	341,863	290,524	248,577
Virginia	121,350	107,744	103,580
Ohio	158,577	168,565	91,017
Indiana	93,165	90,286	80,153
Illinois	406,117	358,054	254,193
Wisconsin	462,435	429,965	345,445
Minnesota	121,612	120,930	77,461
Michigan	287,613	300,316	214,768
Other States	109,393	91,314	65,873
Total United States	44,559,959	39,633,803	31,968,971
Canada	1,546,328	1,773,086	1,631,489
Other foreign countries	3,977		4,476
Grand total	46,110,264	41,406,889	33,604,936

[1] Department of Mines, Harrisburg, Pa.

Table 6 shows the quantity of Pennsylvania anthracite shipped by originating railways in 1937 and 1938, as reported by the Anthracite Institute.

TABLE 6.—*Anthracite shipments by originating railways, 1937–38, in net tons* [1]

	1937	1938
Reading R. R. Co.	9,292,812	7,935,661
Lehigh Valley R. R.	9,232,590	8,203,136
Central R. R. of New Jersey	3,815,414	2,907,036
Delaware, Lackawana & Western R. R.	6,028,524	5,569,657
Delaware & Hudson R. R. Corporation	4,350,232	3,734,537
Pennsylvania R. R.	5,034,142	4,048,644
Erie R. R.	3,629,973	3,455,991
New York, Ontario & Western Ry.	1,568,942	1,741,229
Lehigh & New England R. R.	2,071,740	2,052,135
	45,024,369	39,648,026

[1] Anthracite Institute.

Incomplete returns on shipments of anthracite in 1938 by destinations, compiled and published monthly by the Pennsylvania Department of Mines, show that about 9 percent of the total shipments move by truck; the corresponding figure in 1937 was 8 percent. Most of the anthracite trucked goes to nearby points. In 1938, about 85 percent of the truck shipments were to destinations in Pennsylvania (60 percent within the anthracite region). As might be expected, New Jersey and New York were the next largest markets, with Delaware, Maryland, and the District of Columbia following in decreasing order. Less than 1,000 tons went by truck to New England and insignificant quantities to Ohio and Canada.

Stocks.—At the end of 1938, stocks of anthracite in the hands of railroads, electric-power utilities, and other industrial consumers were 21.4 percent less than at the end of 1937. Railroad stocks dropped 58.4 percent, electric-power-utility stocks 16.1 percent, and stocks of other industrial consumers 11.7 percent. Stocks on upper Lake docks declined 14.8 percent—on Lake Superior 19 percent and on Lake Michigan 10.3 percent. Retail stocks declined 6.2 percent and producers' stocks 32.3 percent.

Recent trends in production and stocks are shown in figure 1.

Promotional and regulatory activities.—The Anthracite Institute carried on its usual activities during 1938. Officials of the institute followed closely proposed Pennsylvania legislation to regulate the industry; filed a brief with the Committee for Reciprocity Information requesting that the Canadian duty on United States anthracite be removed; carried on its statistical services; and continued to cooperate with the Bureau of Mines. No change had been made in the import duty by the close of the year, nor had the excise tax been removed. However, the prospect for removal of the excise tax, provided for in the Canadian Trade Agreement which was provisionally scheduled to go into effect January 1939, probably explained the decrease in exports of anthracite to Canada during the latter months of 1938. The tax was removed in April 1939.

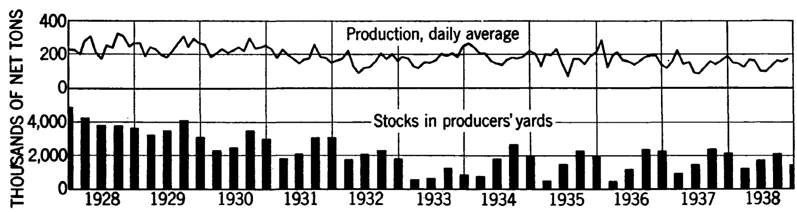

FIGURE 1.—Trends in production and stocks of Pennsylvania anthracite, 1928–38.

Anthracite Industries, Inc., established in the spring of 1936, has become an important agency in developing the market for anthracite and making available to the public higher standards of comfort and convenience in domestic heating. During 1938 Anthracite Industries increased the intensity of its activities. In addition to maintaining first-hand contact with consumers and the trades connected with the industry, its laboratory at Primos, Pa., continued to test for approval anthracite-burning equipment and accessories, and additional schools were conducted to apprise salesmen and others of new developments. Additional showrooms were opened, and the general advertising program was extended.

The first annual anthracite conference, sponsored by Lehigh University was held at Bethlehem, Pa., for 2 days late in April 1938. Papers on reserves, geology, characteristics, and uses of anthracite, description and operation of burning equipment, commercial applications, and merchandising and civic values of anthracite were read and discussed before audiences composed of men interested in all phases of the industry.

The office of the retail solid fuel coordinator of New York City continued its usual duties of policing the New York City market—the largest single anthracite market in the country—against short weight, stolen coal, infractions of coal ordinances, unlicensed truckers, increased freight rates, counterfeit certificates of origin, misrepresentation of coal, and evasion of sales tax and in other details involving the proper operation of the retail industry.

In August 1938, following the report and recommendations of the Pennsylvania Anthracite Coal Industry Commission, bills were introduced in the Pennsylvania House providing for production control; licensing mines; fixing sales quotas and minimum and maximum prices at the mines, as well as retail prices; cooperative marketing; creating an anthracite public authority with power to mine, transport, and sell anthracite, to issue bonds, and to have the right of eminent domain; and, finally, creating the Pennsylvania Anthracite Commission as an independent administrative commission. The House adjourned without passing the bills.

Revisions of the State workmen's compensation act by the Pennsylvania Legislature in 1937 went into effect on January 1, 1938, as did a new law that made occupational diseases compensable. Some operators estimated that the cost to the industry for compensation, which in 1937 approximated $2,500,000, would, under the amended act, eventually amount to $7,500,000 a year. As a result, and as permitted by the law, a substantial majority of the producing companies rejected the act as amended but announced that they would voluntarily settle with all claimants on the basis of the law as operated in 1937.

Technologic developments.—No outstanding change in the methods of mining anthracite was developed during 1938, either underground or in strip pits. To meet intensive competition both within and without the industry, many minor improvements were made in demonstrated and accepted methods, as is usual under the pressure of decreasing costs, without lowering the grade.

The same can be said of the utilization of anthracite. The design of screw-type automatic stokers was further strengthened and refined, and attention was redirected to the thermal efficiency of furnaces and boilers.

In the field of beneficiation of the raw coal—now occupied by the time-tried screens, jigs, and sand cones with certain auxiliary equipment—a new method was announced by Dupont after several years of intensive laboratory and pilot-plant development which culminated in a commercial demonstration plant at the Weston breaker near Shenandoah, Pa. The process employs the familiar float-and-sink method, but its success is based principally on three factors: Development of suitable halogenated hydrocarbons as parting liquids; discovery of surface-active reagents which in solution greatly reduce loss of the parting liquid by preventing it from adhering to the pieces of anthracite; and assembly of standard equipment to form a continuous, water-sealed operation. As developed to date this process is applicable to the domestic sizes of anthracite. It does not remove the need for preliminary and final screening but is alternative to jigs or sand cones. What permanent place it will occupy in the preparation of anthracite for market cannot be foretold.

Sources and acknowledgments.—Annual statistics of the Pennsylvania anthracite-mining industry are prepared from a canvass by mail of all known anthracite operations, including some 400 active producers. About 95 percent of the tonnage is reported directly by producers, and the remaining 5 percent is estimated by personal inspection and collateral evidence. The data furnished by the producers on individual operations 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 1938 operations, when the year as a whole was so critical for the industry.

Final 1937 figures for employment and number of operations were published on September 10, 1938, as a supplement to Weekly Anthracite-Beehive Coke Report 61 and are incorporated in the present Yearbook. Corresponding 1938 figures are not yet available but will be similarly published when completed and included for permanent record in the next volume of the Yearbook. Advance summaries of final production figures for 1938 were published on June 17, 1939, as a supplement to Weekly Anthracite-Beehive Coke Report 101. They are presented in detail in this chapter.

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 1938, in net tons*

Week ended—	Weekly production	Number of working days	Daily average	Week ended—	Weekly production	Number of working days	Daily average
Jan. 1	(1)	(1)	(1)	July 16	557,000	6	92,800
8	847,000	6	141,200	23	639,000	6	106,500
15	1,274,000	6	212,300	30	1,003,000	6	167,200
22	1,367,000	6	227,800	Aug. 6	547,000	6	91,200
29	1,279,000	6	213,200	13	425,000	6	70,800
Feb. 5	1,180,000	6	196,700	20	410,000	6	68,300
12	867,000	6	144,500	27	687,000	6	114,500
19	797,000	6	132,800	Sept. 3	948,000	6	158,000
26	872,000	5.5	158,500	10	516,000	5	103,200
Mar. 5	1,136,000	6	189,300	17	879,000	6	146,500
12	1,057,000	6	176,200	24	819,000	6	136,500
19	664,000	6	110,700	Oct. 1	921,000	6	153,500
26	716,000	6	119,300	8	1,143,000	6	190,500
Apr. 2	877,000	5	175,400	15	1,185,000	6	197,500
9	851,000	6	141,800	22	864,000	6	144,000
16	934,000	6	155,700	29	880,000	5	176,000
23	667,000	6	111,200	Nov. 5	887,000	6	147,800
30	645,000	6	107,500	12	818,000	5	163,600
May 7	859,000	6	143,200	19	858,000	6	143,000
14	844,000	6	140,700	26	653,000	5	130,600
21	1,120,000	6	186,700	Dec. 3	1,214,000	6	202,300
28	1,332,000	6	222,000	10	984,000	6	164,000
June 4	1,174,000	5	234,800	17	957,000	6	159,500
11	898,000	6	149,700	24	1,030,000	6	171,700
18	726,000	6	121,000	31	1,014,000	5	202,800
25	962,000	6	160,300				
July 2	991,000	6	165,200	Calendar year	46,099,000	303.5	151,900
9	325,000	5	65,000				

[1] Jan. 1 considered a full holiday; there were no loadings on that day.

TABLE 8.—*Estimated monthly production of Pennsylvania anthracite, 1935–38* [1]

[Production figures represent thousands of net tons

Month	1935			1936			1937			1938		
	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	5,790	26	223	5,315	26	204	4,236	25	169	4,978	25	199
February	4,652	23.5	198	6,952	24.5	284	3,671	23.5	156	3,646	23.5	155
March	3,228	26	124	3,051	26	117	4,795	27	178	4,257	27	158
April	4,763	25	191	4,757	25	190	6,779	25	271	3,149	25	126
May	5,118	26	197	5,104	25	204	4,361	25	174	4,400	25	176
June	5,724	25	229	4,292	26	165	4,635	26	178	4,450	26	171
July	3,502	26	135	3,912	26	151	2,748	26	106	2,580	25	103
August	3,073	27	114	3,492	26	134	2,903	26	112	2,735	27	101
September	4,113	24	171	3,861	25	154	3,682	25	147	3,388	25	136
October	4,132	26	159	4,593	26	177	4,848	25	194	4,180	25	167
November	3,432	24	143	4,320	23	188	4,439	24	185	3,803	24	159
December	4,632	25	185	4,931	26	190	4,759	26	183	4,533	26	174
	52,159	303.5	172	54,580	304.5	179	51,856	303.5	171	46,099	303.5	152

[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.

By 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 portion of the Southern field lying east of Tamaqua; and the Schuylkill region, which consists of the Western Middle field and the portion of the Southern field lying west of Tamaqua.

The area may also be divided into 4 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, the former for regional comparative trade statistics and the latter for comparative methods and costs of mining as governed by physical conditions.

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 on estimated minable reserves, the Southern field comes first, followed by the Western Middle, the Northern, and the Eastern Middle fields.[3]

[3] Ashley, George H., Anthracite Reserves and Geology: Trans. 1st Ann. Anthracite Conference, April 1938, pp. 11–24.

TABLE 9.—*Pennsylvania anthracite shipped, sold locally, and used as colliery fuel in 1938, by regions*

Region	Shipments		Local sales	
	Net tons	Value [1]	Net tons	Value
Lehigh:				
Breaker product	7,039,520	$29,063,863	272,555	$1,266,319
Dredge product	54,262	62,834		
Total Lehigh	7,093,782	29,126,697	272,555	1,266,319
Schuylkill:				
Breaker product	10,714,017	41,352,715	655,189	2,254,043
Washery product	1,489,529	3,767,480	70,869	253,474
Dredge product	319,163	289,127	166,793	172,239
Total Schuylkill	12,522,709	45,409,322	892,851	2,679,756
Wyoming:				
Breaker product	21,239,085	91,784,934	1,474,886	6,544,477
Washery product	189,980	479,620	24,827	65,625
Dredge product			29,491	45,102
Total Wyoming	21,429,065	92,264,554	1,529,204	6,655,204
Total, excluding Sullivan County:				
Breaker product	38,992,622	162,201,512	2,402,630	10,064,839
Washery product	1,679,509	4,247,100	95,696	319,099
Dredge product	373,425	351,961	196,284	217,341
Total	41,045,556	166,800,573	2,694,610	10,601,279
Sullivan County: [2] Breaker product	18,313	38,991	27,596	80,557
Grand total: 1938	41,063,869	166,839,564	2,722,206	10,681,836
1937	46,203,144	182,302,758	2,981,391	11,673,258
Change, 1938 percent	−11.1	−8.5	−8.7	−8.5

Region	Colliery fuel		Total	
	Net tons	Value	Net tons	Value [1]
Lehigh:				
Breaker product	390,063	$700,781	7,702,138	$31,030,963
Dredge product			54,262	62,834
Total Lehigh	390,063	700,781	7,756,400	31,093,797
Schuylkill:				
Breaker product	471,114	738,109	11,840,320	44,344,867
Washery product	5,875	8,393	1,566,273	4,029,347
Dredge product	1,315	1,277	487,271	462,643
Total Schuylkill	478,304	747,779	13,893,864	48,836,857
Wyoming:				
Breaker product	1,345,627	1,529,397	24,059,598	99,858,808
Washery product	95,684	98,080	310,491	643,325
Dredge product			29,491	45,102
Total Wyoming	1,441,311	1,627,477	24,399,580	100,547,235
Total, excluding Sullivan County:				
Breaker product	2,206,804	2,968,287	43,602,056	175,234,638
Washery product	101,559	106,473	1,876,764	4,672,672
Dredge product	1,315	1,277	571,024	570,579
Total	2,309,678	3,076,037	46,049,844	180,477,889
Sullivan County: [2] Breaker product	3,274	2,730	49,183	122,278
Grand total: 1938	2,312,952	3,078,767	46,099,027	180,600,167
1937	2,671,898	3,622,833	51,856,433	197,598,849
Change, 1938 percent	−13.4	−15.0	−11.1	−8.6

[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] 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, 1934–38, in net tons*

[The figures of breaker product include a certain quantity of culm-bank coal, which amounted to 561,960 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	1934	1935	1936	1937	1938
Eastern Middle:					
Breakers	6, 013, 462	5, 248, 176	6, 102, 979	6, 045, 813	5, 217, 169
Washeries	----------	----------	----------	----------	----------
Total Eastern Middle	6, 013, 462	5, 248, 176	6, 102, 979	6, 045, 813	5, 217, 169
Western Middle:					
Breakers	12, 417, 648	10, 231, 664	11, 469, 078	10, 381, 521	8, 877, 485
Washeries	801, 391	1, 483, 023	1, 510, 913	1, 456, 505	940, 938
Dredges	213, 567	231, 711	221, 800	264, 588	223, 961
Total Western Middle	13, 432, 606	11, 946, 398	13, 201, 791	12, 102, 614	10, 042, 384
Southern:					
Breakers	7, 384, 649	6, 091, 307	6, 439, 213	5, 849, 381	5, 447, 804
Washeries	82, 910	99, 204	438, 465	218, 541	625, 335
Dredges	409, 448	339, 529	303, 984	468, 386	317, 572
Total Southern	7, 877, 007	6, 530, 040	7, 181, 662	6, 536, 308	6, 390, 711
Northern:					
Breakers	29, 322, 571	27, 700, 235	27, 448, 035	26, 707, 743	24, 059, 598
Washeries	302, 540	524, 742	405, 615	347, 959	310, 491
Dredges	29, 165	19, 227	20, 900	27, 500	29, 491
Total Northern	29, 654, 276	28, 244, 204	27, 874, 550	27, 083, 202	24, 399, 580
Total, excluding Sullivan County:					
Breakers	55, 138, 330	49, 271, 382	51, 459, 305	48, 984, 458	43, 602, 056
Washeries	1, 186, 841	2, 106, 969	2, 354, 993	2, 023, 005	1, 876, 764
Dredges	652, 180	590, 467	546, 684	760, 474	571, 024
	56, 977, 351	51, 968, 818	54, 360, 982	51, 767, 937	46, 049, 844
Sullivan County: Breakers	190, 940	189, 965	218, 553	88, 496	49, 183
Grand total	57, 168, 291	52, 158, 783	54, 579, 535	51, 856, 433	46, 099, 027

TABLE 11.—*Pennsylvania anthracite produced in 1938, by counties*

County	Shipments		Local sales	
	Net tons	Value [1]	Net tons	Value
Carbon	1, 685, 815	$6, 598, 294	57, 762	$253, 654
Columbia	783, 542	3, 160, 773	45, 222	120, 721
Dauphin	349, 397	1, 511, 157	111, 987	131, 978
Lackawanna	6, 978, 103	29, 711, 982	674, 806	3, 070, 345
Luzerne	17, 736, 234	76, 815, 018	1, 003, 355	4, 311, 951
Northumberland	3, 883, 344	14, 646, 609	305, 505	774, 005
Schuylkill	9, 381, 919	33, 761, 938	462, 519	1, 863, 664
Sullivan	18, 313	38, 991	27, 596	80, 557
Susquehanna and Wayne	158, 859	497, 726	11, 195	50, 253
Berks, Lebanon, Northampton, and York [2]	88, 343	97, 076	22, 259	24, 708
	41, 063, 869	166, 839, 564	2, 722, 206	10, 681, 836

County	Colliery fuel		Total	
	Net tons	Value	Net tons	Value [1]
Carbon	67, 630	$157, 580	1, 811, 207	$7, 009, 528
Columbia	57, 989	101, 601	886, 753	3, 383, 095
Dauphin	4, 257	6, 635	465, 641	1, 649, 770
Lackawanna	466, 585	579, 724	8, 119, 494	33, 362, 051
Luzerne	1, 188, 762	1, 406, 818	19, 928, 351	82, 533, 787
Northumberland	64, 418	103, 461	4, 253, 267	15, 524, 075
Schuylkill	443, 316	691, 827	10, 287, 754	36, 317, 429
Sullivan	3, 274	2, 730	49, 183	122, 278
Susquehanna and Wayne	16, 721	28, 391	186, 775	576, 370
Berks, Lebanon, Northampton, and York [2]	----------	----------	110, 602	121, 784
	2, 312, 952	3, 078, 767	46, 099, 027	180, 600, 167

[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 all three sources contribute to the country's supply, it is important to consider them all 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 particular 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. The aggregate annual tonnages of culm-bank coal so treated are shown in the last of the following three tables.

TABLE 12.—*Anthracite produced in 1938, 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	558, 360	5, 116, 748	1, 965, 102	53, 037		7, 693, 247
Dredges					54, 262	54, 262
Total Lehigh	558, 360	5, 116, 748	1, 965, 102	53, 037	54, 262	7, 747, 509
Schuylkill:						
Breakers	1, 245, 117	7, 898, 100	2, 207, 144	456, 711		11, 807, 072
Washeries		5, 833	73, 274	1, 485, 185		1, 564, 292
Dredges					487, 271	487, 271
Total Schuylkill	1, 245, 117	7, 903, 933	2, 280, 418	1, 941, 896	487, 271	13, 858, 635
Wyoming:						
Breakers	8, 343, 692	14, 925, 264	832, 629	52, 212		24, 153, 797
Washeries			17, 192	293, 299		310, 491
Dredges					29, 491	29, 491
Total Wyoming	8, 343, 692	14, 925, 264	849, 821	345, 511	29, 491	24, 493, 779
Total, excluding Sullivan County:						
Breakers	10, 147, 169	27, 940, 112	5, 004, 875	561, 960		43, 654, 116
Washeries		5, 833	90, 466	1, 778, 484		1, 874, 783
Dredges					571, 024	571, 024
Total	10, 147, 169	27, 945, 945	5, 095, 341	2, 340, 444	571, 024	46, 099, 923
Sullivan County: Breakers	4, 500	44, 683				49, 183
Grand total: 1938	10, 151, 669	27, 990, 628	5, 095, 341	2, 340, 444	571, 024	46, 149, 106
1937	10, 683, 837	31, 882, 514	5, 696, 018	2, 722, 599	760, 474	51, 745, 442
Change, 1938 percent	−5.0	−12.2	−10.5	−14.0	−24.9	−10.8

TABLE 13.—*Anthracite produced in 1938, 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	556,360	3,236,328	1,404,785	10,805		5,208,278
Western Middle:						
Breakers	1,211,092	6,015,948	1,576,273	44,174		8,847,487
Washeries		5,833	73,274	861,831		940,938
Dredges					223,961	223,961
Total Western Middle	1,211,092	6,021,781	1,649,547	906,005	223,961	10,012,386
Southern:						
Breakers	36,025	3,762,572	1,191,188	454,769		5,444,554
Washeries				623,354		623,354
Dredges					317,572	317,572
Total Southern	36,025	3,762,572	1,191,188	1,078,123	317,572	6,385,480
Northern:						
Breakers	8,343,692	14,925,264	832,629	52,212		24,153,797
Washeries			17,192	293,299		310,491
Dredges					29,491	29,491
Total Northern	8,343,692	14,925,264	849,821	345,511	29,491	24,493,779
Total, excluding Sullivan County:						
Breakers	10,147,169	27,940,112	5,004,875	561,960		43,654,116
Washeries		5,833	90,466	1,778,484		1,874,783
Dredges					571,024	571,024
	10,147,169	27,945,945	5,095,341	2,340,444	571,024	46,099,923
Sullivan County: Breakers	4,500	44,683				49,183
Grand total	10,151,669	27,990,628	5,095,341	2,340,444	571,024	46,149,106

TABLE 14.—*Culm-bank coal put through breakers, 1934–38, by fields, in net tons*

Year	Northern	Eastern Middle	Western Middle	Southern	Total [1]
1934	323,000	131,000	369,000	139,000	962,000
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

[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 1938, 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	26,527	41,718	54,240	2,067	122,485	124,552	---	---	124,552
Egg	318,177	453,710	1,337,144	---	2,109,031	2,109,031	2,531	---	2,111,562
Stove	1,618,213	2,059,946	5,558,435	1,978	9,236,594	9,238,572	46,630	---	9,285,202
Chestnut	1,740,952	2,530,792	5,872,500	4,834	10,144,244	10,149,078	199,587	---	10,348,665
Pea	844,511	1,182,047	2,117,144	3,041	4,143,702	4,146,743	189,710	74	4,336,527
Total domestic	4,548,380	6,268,213	14,939,463	11,920	25,756,056	25,767,976	438,458	74	26,206,508
Buckwheat No. 1	1,100,019	1,747,953	2,913,107	1,938	5,761,079	5,763,017	390,636	5,353	6,159,006
Buckwheat No. 2 (rice)	579,265	938,173	1,497,822	2,696	3,015,260	3,017,956	352,862	16,995	3,387,813
Buckwheat No. 3 (barley)	597,864	1,146,410	1,598,515	---	3,342,789	3,342,789	438,691	199,075	3,980,555
Buckwheat No. 4	205,126	517,409	276,872	---	999,407	999,407	58,126	129,548	1,187,081
Boiler	---	---	---	---	---	---	---	---	---
Other	8,866	95,859	13,306	1,759	118,031	119,790	736	22,380	142,906
Total steam	2,491,140	4,445,804	6,299,622	6,393	13,236,566	13,242,959	1,241,051	373,351	14,857,361
Grand total	7,039,520	10,714,017	21,239,085	18,313	38,992,622	39,010,935	1,679,509	373,425	41,063,869
Value									
Lump [2] and broken	$137,120	$229,268	$279,803	$6,200	$646,191	$652,391	---	---	$652,391
Egg	1,624,436	2,390,888	6,903,931	---	10,919,255	10,919,255	$10,852	---	10,930,107
Stove	8,672,515	11,094,562	29,496,619	5,934	49,263,696	49,269,630	221,423	---	49,491,053
Chestnut	9,445,879	13,689,281	31,240,521	14,502	54,375,681	54,390,183	843,724	---	55,233,907
Pea	3,319,995	4,492,533	8,284,752	7,660	16,097,280	16,104,940	668,674	$444	16,774,058
Total domestic	23,199,945	31,896,532	76,205,626	34,296	131,302.103	131,336.399	1,744,673	444	133,081,516
Buckwheat No. 1	3,366,851	5,119,968	8,979,800	2,910	17,466,619	17,469,529	1,101,785	12,578	18,583,892
Buckwheat No. 2 (rice)	1,365,886	2,129,618	3,583,395	1,340	7,078,899	7,080,239	722,547	27,250	7,830,036
Buckwheat No. 3 (barley)	960,023	1,714,963	2,706,086	---	5,381,072	5,381,072	630,877	195,133	6,207,082
Buckwheat No. 4	166,335	414,969	299,046	---	880,350	880,350	46,813	84,230	1,011,393
Boiler	---	---	---	---	---	---	---	---	---
Other	4,823	76,665	10,981	445	92,469	92,914	405	32,326	125,645
Total steam	5,863,918	9,456,183	15,579,308	4,695	30,899,409	30,904,104	2,502,427	351,517	33,758,048
Grand total	29,063,863	41,352,715	91,784,934	38,991	162,201,512	162,240,503	4,247,100	351,961	166,839,564

[1] Figures of shipments from breakers include 561,960 tons of culm-bank coal handled in the breakers.
[2] The quantity of lump included is insignificant.

TABLE 15.—*Pennsylvania anthracite shipped in 1938, by regions and sizes*—Continued

Size	Breaker shipments						Washery shipments	Dredge shipments	Grand total
	Lehigh region	Schuylkill region	Wyoming region	Sullivan County	Total				
					Excluding Sullivan County	Including Sullivan County			
Average value per ton									
Lump [2] and broken	$5.17	$5.50	$5.16	$3.00	$5.28	$5.24			$5.24
Egg	5.11	5.27	5.16		5.18	5.18	$4.29		5.18
Stove	5.36	5.39	5.31	3.00	5.33	5.33	4.75		5.33
Chestnut	5.43	5.41	5.32	3.00	5.36	5.36	4.23		5.34
Pea	3.93	3.80	3.91	2.52	3.88	3.88	3.52	$6.00	3.87
Total domestic	5.10	5.09	5.10	2.88	5.10	5.10	3.98	6.00	5.08
Buckwheat No. 1	3.06	2.93	3.08	1.50	3.03	3.03	2.82	2.35	3.02
Buckwheat No. 2 (rice)	2.36	2.27	2.39	.50	2.35	2.35	2.05	1.60	2.31
Buckwheat No. 3 (barley)	1.61	1.50	1.69		1.61	1.61	1.44	.98	1.56
Buckwheat No. 4	.81	.80	1.08		.88	.88	.81	.65	.85
Boiler									
Other	.54	.80	.83	.25	.78	.78	.55	1.44	.88
Total steam	2.35	2.13	2.47	.73	2.33	2.33	2.02	.94	2.27
Grand total	4.13	3.86	4.32	2.13	4.16	4.16	2.53	.94	4.06

[2] The quantity of lump included is insignificant.

Table 16 reveals an interregional variation in the breaker production of domestic sizes as related to that of steam sizes and to total production, which is of great importance to the profitable operation of individual properties. The Wyoming region in 1938 produced 70 percent domestic sizes and 30 percent steam sizes from a given tonnage of breaker feed; the Lehigh region 65 percent domestic and 35 percent steam sizes; and the Schuylkill region 58.5 percent domestic and 41.5 percent steam sizes. These percentages are relatively constant from year to year. The variation among the regions is due to differences in the physical situation and condition of the anthracite beds. Its effect is shown in receipts from sales, as the average sales realization per ton of total domestic sizes has ranged from \$2.77 to \$3.57 more than that of total steam sizes over the past 3 years. (See table 17.)

TABLE 16.—*Sizes of Pennsylvania anthracite shipped from breakers, 1936–38, 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		
	1936	1937	1938	1936	1937	1938	1936	1937	1938
Lump [1] and broken	0.3	0.5	0.4	0.4	0.5	0.4	0.3	0.3	0.2
Egg	5.3	4.8	4.5	5.1	4.9	4.2	7.8	6.5	6.3
Stove	20.3	21.0	23.0	17.3	18.1	19.3	24.0	24.7	26.2
Chestnut	26.3	25.6	24.7	23.8	23.0	23.6	28.0	28.1	27.6
Pea	11.4	11.5	12.0	10.7	11.0	11.0	10.0	10.4	10.0
Total domestic	63.6	63.4	64.6	57.3	57.5	58.5	70.1	70.0	70.3
Buckwheat No. 1	16.5	15.9	15.6	16.3	15.8	16.3	14.0	13.7	13.7
Buckwheat No. 2 (rice)	8.5	8.4	8.3	9.6	8.7	8.8	7.5	7.2	7.1
Buckwheat No. 3 (barley)	9.1	9.2	8.5	11.7	11.2	10.7	6.9	7.7	7.5
Boiler	----	----	----	----	----	----	----	----	----
Other, including Buckwheat No. 4	2.3	3.1	3.0	5.1	6.8	5.7	1.5	1.4	1.4
Total steam	36.4	36.6	35.4	42.7	42.5	41.5	29.9	30.0	29.7

Size of coal	Sullivan County			Total					
				Excluding Sullivan County			Including Sullivan County		
Lump [1] and broken	----	----	11.3	0.4	0.4	0.3	0.3	0.4	0.3
Egg	4.0	1.8	----	6.5	5.7	5.4	6.5	5.7	5.4
Stove	13.1	15.9	10.8	21.3	22.2	23.7	21.3	22.1	23.7
Chestnut	17.3	15.8	26.4	26.4	26.2	26.0	26.4	26.2	26.0
Pea	7.9	9.5	16.6	10.4	10.7	10.6	10.4	10.8	10.6
Total domestic	42.3	43.0	65.1	65.0	65.2	66.0	64.9	65.2	66.0
Buckwheat No. 1	9.9	10.2	10.6	15.1	14.7	14.8	15.1	14.7	14.8
Buckwheat No. 2 (rice)	34.9	12.8	14.7	8.3	7.9	7.7	8.4	7.9	7.7
Buckwheat No. 3 (barley)	6.2	----	----	8.8	9.0	8.6	8.8	8.9	8.6
Boiler	----	2.3	----	----	(2)	----	----	(2)	----
Other, including Buckwheat No. 4	6.7	31.7	9.6	2.8	3.2	2.9	2.8	3.3	2.9
Total steam	57.7	57.0	34.9	35.0	34.8	34.0	35.1	34.8	34.0

[1] The quantity of lump included is insignificant.
[2] Less than 0.1 percent.

PRICES AND AVERAGE SALES REALIZATION

The circular price of company stove coal, f. o. b. mine, ranged from a low of $5.50 in May to $6.40 in November and December and averaged $6.07 for the 12 months, an advance of 1.5 percent over the 1937 average. Company Buckwheat No. 1 remained at $3.50 throughout the year, an increase of 4.2 percent over 1937. The wholesale price of Chestnut, on tracks at destination, ranged from a low of $8.95 in May to a high of $9.71 in November and December and averaged $9.45 for the year, or 0.9 percent above the average price in 1937. The wholesale price of Pea was 0.7 percent less than in 1937. (See Fig. 2.)

In the spring of 1938 the temporary open-price filing agreement, which had gone into effect in January but had not operated satisfactorily, was susperseded by a new agreement to be administered by an agency not identified with the industry. More than 85 percent of the total production is embraced by the agreement, which, however, did not include illicit coal. The new agreement lasted nominally throughout the rest of the year.

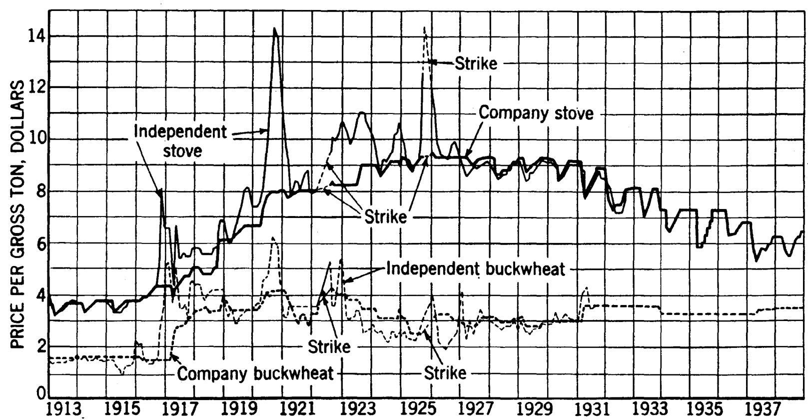

FIGURE 2.—Monthly prices of Pennsylvania anthracite, f. o. b. mine, as quoted by the trade journals, 1913–38. Prices are averages of the range as quoted on the New York market.

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 in question 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 rose to $4.16 in 1938 from $4.03 in 1937. There were small increases in the average realization of all sizes except Pea. (See table 17.)

If local sales, colliery fuel, washery, and dredge coal are included, the average value per net ton on the total 1938 production is $3.92 compared with $3.81 in 1937. (See table 18.)

TABLE 17.—*Average sales realization per net ton on Pennsylvania anthracite shipments from breakers, 1936–38, by regions and sizes*

[Value does not include margins of separately incorporated sales companies]

Size	Lehigh region			Schuylkill region			Wyoming region		
	1936	1937	1938	1936	1937	1938	1936	1937	1938
Lump [1] and broken	$4.99	$4.96	$5.17	$5.18	$5.24	$5.50	$4.97	$5.01	$5.16
Egg	5.51	5.01	5.11	5.61	5.14	5.27	5.62	5.04	5.16
Stove	6.06	5.25	5.36	6.08	5.26	5.39	6.10	5.19	5.31
Chestnut	5.92	5.25	5.43	5.94	5.31	5.41	5.89	5.20	5.32
Pea	4.39	4.04	3.93	4.23	3.96	3.80	4.30	4.02	3.91
Total domestic	5.65	5.01	5.10	5.63	5.02	5.09	5.70	5.00	5.10
Buckwheat No. 1	2.92	2.98	3.06	2.82	2.87	2.93	2.97	3.00	3.08
Buckwheat No. 2 (rice) [2]	2.07	2.29	2.36	1.92	2.17	2.27	2.07	2.31	2.39
Buckwheat No. 3 (barley)	1.26	1.43	1.61	1.09	1.33	1.50	1.36	1.55	1.69
Total steam [3]	2.15	2.24	2.35	1.88	1.99	2.13	2.26	2.37	2.47
Total all sizes	4.38	3.99	4.13	4.03	3.73	3.86	4.67	4.21	4.32

Size	Sullivan County			Total: Excluding Sullivan County			Total: Including Sullivan County		
	1936	1937	1938	1936	1937	1938	1936	1937	1938
Lump [1] and broken			$3.00	$5.05	$5.08	$5.28	$5.05	$5.08	$5.24
Egg	$4.18	$3.97		5.60	5.06	5.18	5.60	5.06	5.18
Stove	5.74	4.46	3.00	6.09	5.21	5.33	6.09	5.21	5.33
Chestnut	4.31	3.07	3.00	5.91	5.23	5.36	5.91	5.23	5.36
Pea	3.81	2.56	2.52	4.30	4.01	3.88	4.30	4.01	3.88
Total domestic	4.65	3.51	2.88	5.67	5.01	5.10	5.67	5.01	5.10
Buckwheat No. 1	2.62	2.00	1.50	2.91	2.95	3.03	2.91	2.95	3.03
Buckwheat No. 2 (rice) [2]	1.47	.75	.50	2.02	2.26	2.35	2.01	2.26	2.35
Buckwheat No. 3 (barley)	.97			1.23	1.45	1.61	1.23	1.45	1.61
Total steam [3]	1.52	1.03	.73	2.10	2.21	2.33	2.10	2.21	2.33
Total all sizes	2.84	2.10	2.13	4.42	4.03	4.16	4.42	4.03	4.16

[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, 1937–38, by regions* [1]

[Note that values in this table include washery and dredge coal]

Region	1937				1938			
	Shipments	Local sales	Colliery fuel	Total production	Shipments	Local sales	Colliery fuel	Total production
Lehigh	$3.98	$4.71	$1.55	$3.89	$4.11	$4.65	$1.80	$4.01
Schuylkill	3.54	2.78	1.54	3.43	3.63	3.00	1.56	3.51
Wyoming	4.19	4.34	1.25	4.02	4.31	4.35	1.13	4.12
Total, excluding Sullivan County	3.95	3.93	1.36	3.81	4.06	3.93	1.33	3.92
Sullivan County	2.10	3.04	.58	2.45	2.13	2.92	.83	2.49
Grand total	3.95	3.92	1.36	3.81	4.06	3.92	1.33	3.92

[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 328 in 1936 to 390 in 1937. (See table 19.) Figures for 1938 are not yet available, but indications are that the upward trend continued.

TABLE 19.—*Number of active operations in the Pennsylvania anthracite industry in 1937* [1]

Region and type of product	Total active plants reporting [2]	Breakers [3]	Other preparation plants [4]	Washeries [5]	Culm banks operated in conjunction with breakers	Dredges	Reporting strip-pit tonnage
Lehigh:							
Breakers or mines	35	24	1		10		25
Dredges	1		1			1	
Total Lehigh	36	24	2		10	1	25
Schuylkill:							
Breakers or mines	75	38	18		11		36
Washeries	15			4			1
Dredges	27		22			27	
Total Schuylkill	117	38	40	4	11	27	37
Wyoming:							
Breakers or mines	219	69	4		6		27
Washeries	12			2			
Dredges	1		1			1	
Total Wyoming	232	69	5	2	6	1	27
Total, excluding Sullivan County:							
Breakers	329	131	23		27		88
Washeries	27			6			1
Dredges	29		24			29	
Total	385	131	47	6	27	29	89
Sullivan County: Breakers	5	5					
Grand total	390	136	47	6	27	29	89

[1] Figures for 1938 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 nearly 97,000 men were employed at anthracite mines in 1938. The number employed in 1937, as based on direct reports from operators and including the employees of dredges and strip contractors, was 99,085.

Man-days lost on account of strikes were 42.5 percent greater in 1937 than in 1936. Suspension of work due to strikes and the number of men involved also were greater in 1937 than in 1936. Comparable statistics covering 1938 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 $14.76 in July to a high of $28.94 in June and averaged $23.40 during 1938, or 7.1 percent below the 1937 average. The index of employment (1929 average equals 100) fluctuated between 37.6 in August and 60.0 in February and averaged 13.1 below 1937. The index of pay rolls reached a low of 20.0 in August and a high of 49.7 in June and averaged 18.6 below 1937.

159434—39——55

TABLE 20.—*Men employed and days worked at operations producing Pennsylvania anthracite in 1937* [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 product	7,167	4,002	11,169	1,629	1,333	3,066	6,028	17,197	182	3,137,357	2.67
Dredge product					4	7	11	11	134	1,474	20.08
Total Lehigh	7,167	4,002	11,169	1,629	1,337	3,073	6,039	17,208	182	3,138,831	2.68
Schuylkill:											
Breaker product	11,311	5,899	17,210	2,330	2,133	3,489	7,952	25,162	196	4,939,816	2.81
Washery product				65	215	361	641	641	195	124,738	[2] 13.43
Dredge product					91	157	248	248	219	54,334	12.95
Total Schuylkill	11,311	5,899	17,210	2,395	2,439	4,007	8,841	26,051	196	5,118,888	3.18
Wyoming:											
Breaker product	31,852	13,865	45,717	561	2,578	6,475	9,614	55,331	188	10,421,645	2.56
Washery product					35	25	60	60	137	8,242	[2] 15.24
Dredge product					16	8	24	24	194	4,656	5.91
Total Wyoming	31,852	13,865	45,717	561	2,629	6,508	9,698	55,415	188	10,434,543	2.60
Total, excluding Sullivan County:											
Breaker product	50,330	23,766	74,096	4,520	6,044	13,030	23,594	[3] 97,690	189	18,498,818	2.65
Washery product				65	250	386	701	701	190	132,980	[2] 13.54
Dredge product					111	172	283	283	214	60,464	12.58
Total	50,330	23,766	74,096	4,585	6,405	13,588	24,578	98,674	189	18,692,262	2.77
Sullivan County: Breaker product	214	85	299		31	81	112	411	118	48,497	1.82
Grand total	50,544	23,851	74,395	4,585	6,436	13,669	24,690	99,085	189	18,740,759	2.77

[1] Figures for 1938 not yet available.
[2] Represents washeries for which both production and employment were separately reported.
[3] The men shown for "breaker product" include a considerable number of washery employees who could not be separated from breaker employees.

13669
6436
20105

TABLE 21.—*Men employed at operations producing Pennsylvania anthracite in 1937, by counties* [1]

[Includes operations of strip contractors]

County	Men	County	Men
Carbon	4,134	Schuylkill	20,697
Columbia	977	Sullivan	411
Dauphin	1,035	Susquehanna and Wayne	314
Lackawanna	18,584	Berks, Lebanon, Northampton, and York[2]	42
Luzerne	44,716		
Northumberland	8,175		99,085

[1] Figures for 1938 not yet available.
[2] Counties producing dredge coal only.

TABLE 22.—*Strikes, suspensions, and lock-outs in the Pennsylvania anthracite region in 1937* [1]

	Lehigh	Schuylkill	Wyoming	Sullivan County	Total: Excluding Sullivan County	Total: Including Sullivan County
Total number employed	17,208	26,051	55,415	411	98,674	99,085
Men on strike	10,139	14,614	9,593		34,346	34,346
Man-days lost on account of strike	294,449	209,962	76,051		580,462	580,462
Average days lost—						
Per man employed	17.1	8.1	1.4		5.9	5.9
Per man on strike	29.0	14.4	7.9		16.9	16.9

[1] Figures for 1938 not yet available.

EQUIPMENT AND METHODS OF MINING

Mechanical loading.—Anthracite loaded mechanically underground continued to represent about one-fourth of the total deep-mined production. In 1938 the 10,151,669 tons so loaded were 26.6 percent of the total underground output compared with 25 percent (10,684,000 tons) in 1937 and 24.2 percent (10,827,946 tons) in 1936. The 5-percent decline in tonnage loaded mechanically from 1937 to 1938 was slight compared with the 12.2-percent decrease in quantity loaded by hand and the 11.1-percent drop in total tonnage.

In 1938 sales of both scrapers and conveyors in the Pennsylvania anthracite region were below the 1937 figures. Sales of scrapers declined from 16 in 1937 to 4 in 1938 and of conveyors (including hand-loaded conveyors and conveyors equipped with duckbills or other self-loading heads) from 260 to 241 units. No sales of mobile loading machines were reported.

The number of scrapers in use increased from 539 in 1937 to 545 in 1938, but the number of pit-carloaders and conveyors (with duckbills and other self-loading heads and hand-loaded) dropped from 1,855 to 1,831. These figures include the limited mobile-loading equipment reported in the field, as shown in table 24.

TABLE 23.—*Relative growth of mechanical loading, hand loading, and stripping in Pennsylvania anthracite mines, 1934–38*

[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
1934	9,284,000	5,798,000	39,290,000	418	269	55
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

TABLE 24.—*Pennsylvania anthracite loaded mechanically underground, 1934–38*

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
1934	[2] 531	[2] 3,017,741	1,376	6,266,745	1,907	9,284,486
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

[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 1938, by fields, in net tons*

Field	Scraper loaders	Pit-car loaders	Hand-loaded face conveyors, all types [1]	Total mechanically loaded underground
Northern	2,153,164		6,195,028	8,348,192
Eastern Middle	114,034	25,620	416,706	556,360
Western Middle	} 322,756	7,681	{ 890,180	1,211,092
Southern			[2] 26,500	36,025
	2,589,954	33,301	7,528,414	10,151,669

[1] Shaker chutes, etc., including those equipped with duckbills.
[2] Includes tonnage by mobile loaders.

Cutting machines.—The number of cutting machines in use in 1938 was greater than in 1937, but the tonnage cut by machine was less.

TABLE 26.—*Pennsylvania anthracite cut by machines, 1937–38*

Region	1937			1938		
	Cutting machines		Net tons cut by machines	Cutting machines		Net tons cut by machines
	Permissible	All other types		Permissible	All other types	
Lehigh						
Schuylkill	3	3	41,149			
Wyoming	137	75	1,911,149	150	89	1,583,907
Total, excluding Sullivan County	140	78	1,952,298	150	89	1,583,907
Sullivan County	2	3	32,214		3	4,500
Grand total	142	81	1,984,512	150	92	1,588,407

Strip-pit mining.—The percentage of anthracite produced from strip pits compared with fresh-mined anthracite remained virtually constant—11.8 percent in 1938 and 11.9 percent in 1937. The tonnage mined by this method in 1938 fell slightly in the Lehigh region and 25 percent in the Schuylkill region but increased 34 percent in the Wyoming region. Table 27 gives the figures for several years.

TABLE 27.—*Relative growth of Pennsylvania anthracite mined from strip pits, 1915, 1920, 1925, 1930, and 1936–38, 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)
1936	364	6,203,267	17,042	12.2	4,667	199
1937	351	5,696,018	16,228	11.9	4,585	184
1938:						
Lehigh region	123	1,965,102	15,976	25.7	(2)	(2)
Schuylkill region	119	2,280,418	19,163	20.0	(2)	(2)
Wyoming region	89	849,821	9,549	3.5	(2)	(2)
Total, 1938 [3]	[4] 331	5,095,341	15,394	11.8	(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 1938.
[4] Incudes 102 gasoline, 22 steam, 64 electric, 133 Diesel, and 10 other types of shovels.

Dredge operations.—Both the tonnage and average value of anthracite produced by dredges declined in 1938 compared with 1937.

TABLE 28.—*Anthracite produced by dredges, 1937–38, by rivers*

River (including tributaries)	1937			1938		
	Dredges	Net tons	Value	Dredges	Net tons	Value
Lehigh, Schuylkill	4	95,065	$96,089	5	123,452	$124,795
Susquehanna	25	665,409	745,963	29	447,572	445,784
	29	760,474	842,052	34	571,024	570,579

TABLE 29.—*Average receipts per net ton on all dredge coal sold, 1933–38*

Year	Average receipts	Year	Average receipts
1933	$0.84	1936	$1.06
1934	.98	1937	1.11
1935	.88	1938	1.00

FOREIGN TRADE [4]

Imports.—Imports of anthracite declined from 395,737 tons in 1937 to 362,895 in 1938, or 8.3 percent. In 1938 imports were equivalent to 19 percent of exports compared with 21 percent in 1937.

TABLE 30.—*Anthracite imported for consumption in the United States, 1937–38, by countries, in net tons*

Country	1937	1938	Country	1937	1938
Canada	4,308	2,487	United Kingdom	124,983	154,104
Indochina		5,824		395,737	362,895
U. S. S. R.	266,446	200,480			

TABLE 31.—*Anthracite imported for consumption in the United States, 1937–38, by customs districts, in net tons*

Customs district	1937	1938	Customs district	1937	1938
Buffalo	425		Michigan		29
Connecticut	12,611	11,320	Rhode Island	62,551	54,642
Maine and New Hampshire	32,766	32,436	Vermont		3
Massachusetts	287,384	264,465		395,737	362,895

[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.

Exports.—Exports of anthracite totaled 1,908,911 tons in 1938 compared with 1,914,173 tons in 1937, a decline of 0.3 percent.

TABLE 32.—*Anthracite exported from the United States, 1937–38, by countries, in net tons*

Country	1937	1938
North America:		
Bermuda	1,652	1,175
Canada	1,893,334	1,895,718
Central America:		
British Honduras	1	----------
Guatemala	4	13
Honduras	64	----------
Nicaragua	1	22
Panama	44	1
Mexico	373	179
Miquelon and St. Pierre Islands	----------	45
Newfoundland and Labrador	15,280	7,471
West Indies:		
British:		
Barbados	58	----------
Jamaica	----------	11
Trinidad and Tobago	----------	22
Other British	214	268
Cuba	1,317	----------
Dominican Republic	1	2
French	----------	2,865
Haiti	30	----------
Netherland	57	6
South America:		
Bolivia	----------	265
Brazil	224	672
Colombia	14	3
Guiana:		
British	270	----------
Surinam	11	----------
Peru	1	----------
Venezuela	10	15
Europe:		
France	56	8
United Kingdom	2	----------
Asia:		
Japan	----------	149
Saudi Arabia	----------	1
Africa: Mozambique	1,155	----------
	1,914,173	1,908,911

TABLE 33.—*Anthracite exported from the United States, 1937–38, by customs districts and ports of export, in net tons*

Customs district	1937	1938
North Atlantic:		
Maine and New Hampshire	79	20
Massachusetts	40	294
New York	28,861	33,756
Philadelphia	23,531	34,908
South Atlantic:		
Maryland	5,004	459
Virginia	----------	2,865
Gulf Coast:		
Florida	71	81
Mobile	281	----------
New Orleans	66	6
Mexican border:		
Arizona	56	59
El Paso	203	108
San Antonio	2	----------
Pacific Coast:		
Alaska	45	269
Los Angeles	3	149
San Diego	77	12
San Francisco	31	8
Washington	279	----------
Northern Border:		
Buffalo	1,308,775	1,273,807
Dakota	922	379
Duluth and Superior	5,093	4,234
Michigan	3,013	4
Ohio	16,883	5,068
Rochester	150,933	165,853
St. Lawrence	369,220	385,011
Vermont	704	1,561
Miscellaneous: Virgin Islands	1	----------
	1,914,173	1,908,911

The Canadian market.—In 1937 and 1938, 56 and 53 percent, respectively, of Canadian imports of anthracite came from the United States. Not since 1932 had Pennsylvania anthracite occupied so favorable a position over competitors in the Canadian market. Bituminous coal imported into Canada from the United States in 1938 maintained its usual high percentage, but there was a marked decline in tonnage from 1937.

Complete data on fuel and power consumption in Canada in 1938 are not available, but indications point to a decline in coal and lignite production and a decided drop in imports compared to 1937.

The trend toward increased consumption of natural gas, fuel oils, and water power in recent years was continued in 1937 and 1938. The total mineral fuels and water power, in terms of coal, available in 1937 will considerably exceed the figure for 1936 [5] and may reach that for the peak year 1929, but a marked decrease in available coal in 1938 may depress the aggregate consumption of these power resources for the country to the 1928 and 1936 levels, or to the equivalent of about 50,000,000 tons of coal. The following table gives data on the coal and coke industry and trade of Canada in 1937 and 1938.

TABLE 34.—*Coal and coke industry and foreign trade of Canada, 1937–38* [1]

[Thousands of net tons]

	Anthracite		Bituminous		Subbituminous		Lignite		Total coal		Coke from coal	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Production	-----	-----	11,635	10,289	506	489	3,695	3,470	15,836	14,248	2,570	2,356
Imports:												
United States	1,995	1,974	12,339	9,644	-----	-----	1	3	14,335	11,621	405	407
Great Britain	1,135	1,199	56	66	-----	-----	-----	-----	1,191	1,265	4	3
Germany	274	407	54	35	-----	-----	-----	-----	328	442	9	5
Belgium	8	34	-----	-----	-----	-----	-----	-----	8	34	-----	-----
French Indochina	-----	30	-----	-----	-----	-----	-----	-----	-----	30	-----	-----
Netherlands	-----	37	-----	-----	-----	-----	-----	-----	-----	37	-----	-----
U. S. S. R.	161	15	-----	-----	-----	-----	-----	-----	161	15	-----	-----
Morocco	-----	20	-----	-----	-----	-----	-----	-----	-----	20	-----	-----
Total imports	3,573	3,716	12,449	9,745	-----	-----	1	3	16,023	13,464	418	415
Exports	-----	-----	345	344	-----	-----	10	9	355	353	37	31
Available for consumption	3,573	3,716	23,739	19,690	506	489	3,686	3,464	31,504	27,359	2,951	2,740

[1] Coal statistics for 1937 are from Coal Statistics for Canada for the Calendar Year 1937, p. 29, Table 29. Coal statistics for 1938 are from Quarterly Coal and Coke Statistics for Canada, October–December 1938, pp. 4, 5, and 14. Coke statistics are from Quarterly Coal and Coke Statistics, October–December 1937, p. 13, and October–December 1938, pp. 14 and 16. Canadian coal charged to ovens in 1937, 1,162,247 tons; 1938, 1,064,302 tons. Imported coal charged to ovens in 1937, 2,415,095 tons; 1938, 2,215,469 tons.

Preliminary figures, in terms of coal, show that Canadian consumption of natural gas increased from 1,125,000 tons in 1936 to 1,295,000 tons in 1937 and 1,326,000 tons in 1938, and that of fuel and gas oils from 3,259,000 tons in 1936 to 3,539,000 tons in 1937.

Apparently there is a wide variation in the prices paid by Canadian importers for anthracite. The invoice value is based on the fair market value or price of anthracite sold for home consumption in the principal markets of the country of origin at the time shipment is made, but the value must not be less than the price to jobbers and wholesalers generally nor less than the actual cost of production at the time of shipment, plus a reasonable advance for cost of selling and profit.

In 1937 and 1938, respectively, the price per net ton for domestic sizes, except Pea, of anthracite from Great Britain was reported as $5.37 and $5.83; from the United States, $5.62 and $5.74; from Germany, $4.27 and $4.33; and from the U. S. S. R., $2.37 and $4.54.[6]

As the United States is the source of virtually all the bituminous coal imported into Canada the extent of Canadian subventions in aid of its coal industry is of interest. The tonnage of Canadian coal

[5] Minerals Yearbook, 1938, p. 754.
[6] Trade of Canada, Calendar Year 1938, p. 408.

moved under assisted (railroad) rates amounted to 146,000 net tons in 1928, reached 1,149,000 tons in 1932, and was 2,182,000, 2,356,000, and 2,637,000 net tons in 1935, 1936, and 1937. Of the 1937 tonnage, 1,909,000 tons came from Nova Scotia and most of the remainder from Alberta, Saskatchewan, and British Columbia.[7]

It is understood that a further increase in subventions was granted the Nova Scotia industry late in 1938, in which year the cost of the subsidies totaled $1,858,000.

[7] Coal Statistics for Canada, 1937, p. 105

COKE AND BYPRODUCTS[1]

By H. L. Bennit

SUMMARY OUTLINE

The coke industry shared the general business recession of 1938. Outstanding in the record of coke production during the year was the fact that for the first time since 1932 output failed to increase over that of the preceding year.

Total output from byproduct and beehive ovens in 1938 fell from 52,375,469 to 32,633,304 tons, a decrease of 19,742,165 tons or nearly 38 percent from 1937. Compared with the peak year 1929 when output totaled 59,883,845 tons, the decrease was more than 45 percent.

Of the total production in 1938 byproduct ovens contributed 31,795,892 tons (97.4 percent) and beehive ovens 837,412 tons (2.6 percent). At byproduct plants output decreased from 49,210,748 tons in 1937 to 31,795,892 in 1938, a loss of 17,414,856 tons (35.4 percent). The bulk of this decline occurred at "furnace" coke plants, where output, reflecting the drastic curtailment at blast-furnace operations, dropped 43 percent. At merchant plants (including public utility plants operating byproduct-coke ovens), output declined only 15 percent. The difference in the rate of decrease is explained by the difference in stability of the markets supplied by the two classes of plants. The greater part of the output of furnace plants is used in blast furnaces, which were affected much more by the industrial recession than the coke industry as a whole.

The trend of activity in the coke industry during 1938 was represented by two distinctly opposite movements. The first 6 months were characterized by continuation of the sharp downward curve that began in September 1937 and terminated with a low production point of 2,116,300 tons in June 1938; a definite upward movement followed,

[1] Data for byproduct coke in 1938 are preliminary: for beehive coke they are final. Detailed statistics with final revisions will be released later.

and output climbed steadily to a high point of 3,438,400 tons in December. Production in the latter half of 1938 exceeded that of the first half by more than 2,000,000 tons.

An adequate supply of byproduct coke for furnace use checked the beehive-coke "boomlet" that flourished throughout 1937 until the last 2 months of the year. Beginning with a production of 114,100 tons in January 1938 and ending with an output of only 75,600 tons in December the yearly total of 837,400 tons decreased 74 percent from 1937.

Stocks of byproduct coke, which ordinarily rise as production falls, were up 1,090,374 tons (43 percent) by the end of the year; at merchant plants the increase was 57 percent, while at furnace plants stock piles rose only 24 percent. At the average daily rate of production throughout the year reserves at the end of December would have sufficed for a little more than 41 days. Supplies of coking coal in stock at byproduct plants showed only seasonal variation during the year, the quantity on hand at the end of the year—7,462,163 tons—being less than 3 percent over the 1937 total.

Imports for consumption declined 53 percent and exports 8 percent, the indicated consumption of all coke being 39 percent less than in 1937.

Shipments of all coke by rail throughout the country dropped 46 percent below the 1937 level, while the volume of river commerce via the Allegheny River decreased 47 percent, via the Monongahela River 31 percent, and via the Ohio River 17 percent.

A selected list of retail dealers reported that deliveries were 40 percent under 1937, while stocks at the same yards decreased 22 percent.

Circular prices for the various grades of coke, quoted by trade journals, showed a rising tendency in general, the only important exception being a decline in the asking price of Connellsville furnace coke. Actual reports received from operators of beehive coke plants indicate a slight increase in total sales-realization averages.

In the field of byproducts, the only statistics available for 1938 cover ammonia and benzol; production data for these commodities indicate decreases of 30 and 39 percent, respectively, from 1937.

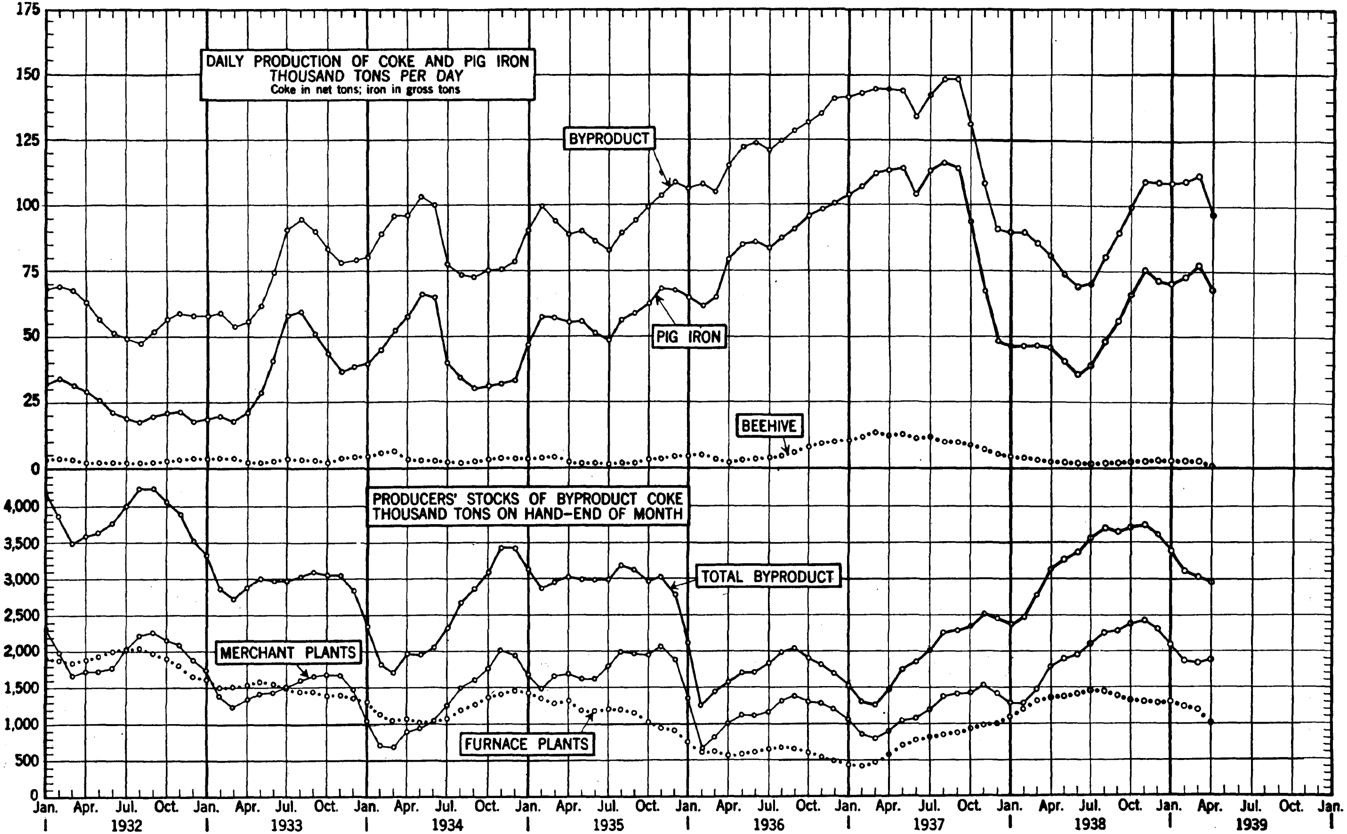

FIGURE 1.—Average daily production of beehive and byproduct coke and pig iron; and producers' stocks of byproduct coke, 1932–39, by months.

TABLE 1.—*Salient statistics of the coke industry in 1937* [1]

	Byproduct	Beehive	Total
Coke produced:			
At merchant plants:			
Quantity ... net tons	13,076,539		13,076,539
Value	$84,334,632		$84,334,632
At furnace plants:			
Quantity ... net tons	36,134,209		36,134,209
Value	$163,021,120		$163,021,120
Total:			
Quantity ... net tons	49,210,748	3,164,721	52,375,469
Value	$247,355,752	$13,648,151	$261,003,903
Screenings or breeze produced:			
Quantity ... net tons	3,883,698	101,057	3,984,755
Value	$7,954,608	$133,060	$8,087,668
Coal charged into ovens:			
Quantity ... net tons	69,575,373	4,926,824	74,502,197
Value	$260,453,698	$9,886,416	$270,340,114
Average value per ton	$3.74	$2.01	$3.63
Average yield in percent of coal charged:			
Coke	70.73	64.23	70.30
Breeze (at plants actually recovering)	5.58	4.21	5.54
Ovens:			
In existence Jan. 1	12,849	13,012	25,861
In existence Dec. 31	12,718	12,194	24,912
Dismantled during year	483	749	1,232
In course of construction Dec. 31	259		259
Daily capacity of ovens Dec. 31	171,855	(2)	(2)
Coke used by operator:			
In blast furnaces:			
Quantity ... net tons	30,418,919	262,394	30,681,313
Value	$134,820,212	$1,389,449	$136,209,661
To make producer or water gas:			
Quantity ... net tons	1,281,965		1,281,965
Value	$6,733,272		$6,733,272
For other purposes:			
Quantity ... net tons	529,013	1,516	530,529
Value	$2,744,853	$6,996	$2,751,849
Disposition of coke:			
Sold to financially affiliated corporations:			
For blast-furnace use:			
Quantity ... net tons	2,691,390	405,661	3,097,051
Value	$12,209,263	$1,661,596	$13,870,859
For all other purposes:			
Quantity ... net tons	734,056	4,204	738,260
Value	$4,360,297	$21,874	$4,382,171
Sold to other consumers:			
For blast-furnace use:			
Quantity ... net tons	1,620,182	1,353,423	2,973,605
Value	$7,027,340	$5,518,733	$12,546,073
For foundry use:			
Quantity ... net tons	1,700,405	338,417	2,038,822
Value	$14,403,621	$1,729,632	$16,133,253
For manufacture of water gas:			
Quantity ... net tons	470,394	92,039	562,433
Value	$3,145,958	$369,969	$3,515,927
For other industrial use:			
Quantity ... net tons	1,125,896	358,811	1,484,707
Value	$6,554,681	$1,587,854	$8,142,535
For domestic use:			
Quantity ... net tons	7,807,792	299,726	8,107,518
Value	$50,997,240	$1,166,039	$52,163,279
Disposition of screenings or breeze:			
Used by operator:			
For raising steam:			
Quantity ... net tons	2,754,533	5,786	2,760,319
Value	$5,223,096	$7,514	$5,230,610
To make producer or water gas:			
Quantity ... net tons	79,566		79,566
Value	$292,872		$292,872
For other purposes:			
Quantity ... net tons	371,533	2,393	373,926
Value	$719,621	$1,489	$721,110
Sold:			
Quantity ... net tons	657,145	53,090	710,235
Value	$1,535,137	$73,322	$1,608,459
Average receipts per ton sold:			
Furnace coke (merchant sales)	$4.34	$4.08	$4.22
Foundry coke	$8.47	$5.11	$7.91
Domestic coke	$6.53	$3.89	$6.43
For manufacture of water gas	$6.69	$4.02	$6.25
Other industrial coke	$5.82	$4.43	$5.48
Screenings or breeze	$2.34	$1.38	$2.26

[1] Figures for 1938 not yet available.

[2] Data not available.

TABLE 1.—*Salient statistics of the coke industry in 1937*—Continued

	Byproduct	Beehive	Total
Stocks on hand on Jan. 1, 1938:			
Furnace net tons	610,840	13,542	624,382
Foundry do	29,828	13,264	43,092
Domestic and other do	1,878,652	49,161	1,927,813
Breeze do	277,367	7,166	284,533
Exports do			526,683
Imports do			286,364
Calculated consumption do			51,271,929
Byproducts produced:			
Gas M cubic feet	757,628,942		757,628,942
Wasted percent	1.84		1.84
Burned in coking process do	37.04		37.04
Surplus sold or used do	61.12		61.12
Tar gallons	603,053,288		603,053,288
Ammonium sulfate or equivalent pounds	1,506,431,251		1,506,431,251
Crude light oil gallons	187,054,346		187,054,346
Yield of byproducts per ton of coal:			
Gas M cubic feet	10.89		10.89
Tar gallons	8.67		8.67
Ammonium sulfate or equivalent pounds	21.84		21.84
Crude light oil gallons	2.86		2.86
Value of byproducts sold:			
Gas (surplus)	$72,961,697		$72,961,697
Tar:			
Sold	$18,456,483		$18,456,483
Used by producer	$10,490,075		$10,490,075
Ammonium sulfate or equivalent	$16,048,325		$16,048,325
Crude light oil and derivatives	$20,215,404		$20,215,404
Other byproducts [3]	$4,442,929		$4,442,929
Total value of coke, breeze, and byproducts [4]	$397,925,273	$13,781,211	$411,706,484

[3] Includes naphthalene and tar derivatives.
[4] Includes value of tar used by coke plants.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1935–38*

	1923	1935	1936	1937	1938 [1]
Coke produced:					
Beehive net tons	19,379,870	917,208	1,706,063	3,164,721	837,412
Byproduct do	37,597,664	34,224,053	44,569,121	49,210,748	31,795,892
Total do	56,977,534	35,141,261	46,275,184	52,375,469	32,633,304
Percent of total from byproduct ovens	66.0	97.4	96.3	94.0	97.4
Stocks of producers, end of year, all coke net tons	[2] 1,221,737	2,829,384	1,732,066	2,595,287	3,654,625
Exports, all coke do	1,237,342	613,975	670,312	526,683	486,571
Imports, all coke [3] do	85,002	317,379	329,957	286,364	135,240
Consumption, calculated, all coke do	55,173,457	35,613,824	47,032,147	51,271,929	31,222,635
Disposal of coke (beehive and byproduct):					
Furnace coke (including all coke used by producer) net tons	47,774,408	22,586,613	[4] 30,772,156	36,751,969	(5)
Foundry coke do	3,600,719	1,484,453	1,921,817	2,038,822	(5)
Other industrial (including water gas) net tons	2,283,888	2,236,112	[4] 2,032,774	2,047,140	(5)
Domestic coke do	2,733,414	9,426,386	[4] 10,021,343	8,107,518	7,193,306
Ovens:					
Beehive, in existence, end of year	62,349	13,674	13,012	12,194	10,816
Byproduct, in existence, end of year	11,156	12,860	12,849	12,718	(5)
Byproduct under construction, end of year	629	122	305	259	130
Cost of coal charged, byproduct ovens, average per ton	$4.76	$3.82	$3.69	$3.74	(5)
Prices of coke:					
Average spot price of Connellsville furnace coke, f. o. b. ovens	$5.33	$3.61	$3.68	$4.29	$3.86
Average realization on byproduct coke sold:					
Furnace coke (merchant sales)	$6.74	$4.77	$5.09	$4.34	(5)
Foundry coke	$10.54	$6.96	$7.44	$8.47	(5)
Other industrial (including water gas)	$9.06	$5.41	$5.51	$6.08	(5)
Domestic	$9.05	$5.84	$6.07	$6.53	(5)

[1] Subject to revision. [2] Furnace and foundry coke only.
[3] Prior to 1934 the figures represent general imports; beginning with 1934 they represent imports for consumption only.
[4] Revised figures. [5] Data not available.

TABLE 2.—*Statistical trends of the coke industry, 1923 and 1935–38*—Continued

	1923	1935	1936	1937	1938 [1]
Yield of byproducts per ton of coal charged:					
Tar..........gallons..	8.1	9.18	8.86	8.67	(5)
Ammonium sulfate or equivalent pounds..	21.2	22.59	22.14	21.84	23.33
Light oil..........gallons..	2.7	2.98	2.91	2.86	(5)
Surplus gas sold or used..M cubic feet..	5.9	7.04	[4] 6.85	6.66	(5)
Average gross receipts of byproducts per ton of coke produced:					
Tar sold and used..........	$0.51	$0.528	$0.541	$0.588	(5)
Ammonia and its compounds..........	$0.84	$0.310	$0.287	$0.326	(5)
Light oil and its derivatives..........	$0.51	$0.435	[4] $0.438	$0.435	(5)
Surplus gas sold or used..........	$1.37	$1.832	$1.589	$1.483	(5)
Total byproducts, including breeze......	$3.48	$3.317	[4] $3.057	$3.060	(5)

[1] Subject to revision. [4] Revised figures. [5] Data not available.

SCOPE OF REPORT

Owing to reduction in the funds appropriated for collection by the Bureau of Mines of statistical and economic data relating to the fuel industries it has been impossible to complete the 1938 annual canvass of the byproduct coke industry in time to publish the final data in the present Minerals Yearbook. In the majority of instances the preliminary data presented were furnished currently by the coke operators and will vary within a fraction of 1 percent from the final detailed statistics. The statistics pertaining to the beehive coke industry in this issue are complete and final. Final detailed statistics of both branches of the industry will be distributed in mimeographed form as soon as available and will be incorporated with 1939 data in the next volume of the Yearbook. If not readily found any derivative figures carried in earlier reports will be furnished by the Bureau upon application.

In the United States coke is produced by a group of four different industries. In addition to that manufactured in the familiar beehive and byproduct ovens coke is obtained in the refining of petroleum, in the manufacture of coal gas, and in the refining of tar. Within the last few years, also, production of a smokeless fuel by low-temperature carbonization of coal has been established commercially in the United States. The coke produced by each of these processes, however, varies greatly in character, and the problems affecting each of the industries are separate and distinct.

In 1938 about 1,602,200 tons of petroleum coke were produced compared with an output of 1,306,600 tons in 1937; approximately 918,400 tons of gas-house coke were made, a slight decrease from the 1937 output of 941,000 tons. The manufacture of coke from coal-tar pitch has been established on a commercial basis, but the tonnage produced is relatively small; in fact, the production in 1937—the latest year for which figures are available—amounted to only 181,495 tons, as reported by the United States Tariff Commission. None of these other kinds of coke are discussed in this report. Only coke from byproduct and beehive ovens is adapted to blast-furnace and foundry uses, which consume the bulk 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 of byproduct coke in this chapter cover the operations of all byproduct coke ovens, including those installed and operated by public utilities engaged primarily in manufacturing gas for city supply.

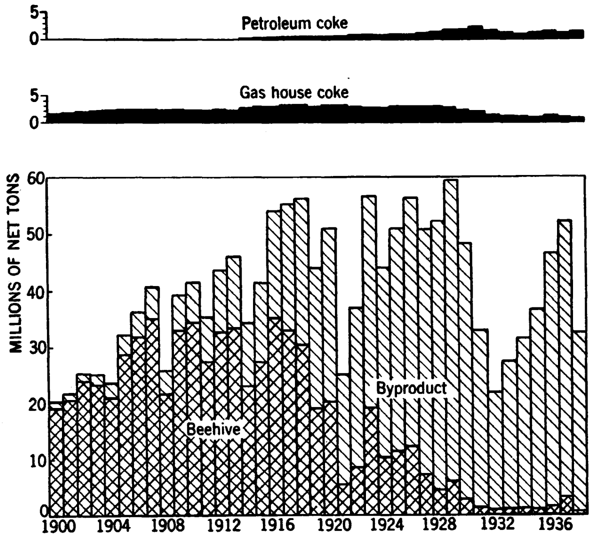

FIGURE 2.—Production of petroleum coke, gas-house coke, and beehive and byproduct coke in the United States, 1900–38. No figures on production of petroleum coke are available before 1914, when the production was 213,777 tons.

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, 1935–38, by months, and average per day, in net tons*

Month	1935		1936		1937		1938 [1]	
	Total	Daily average	Total	Daily average	Total	Daily average	Total	Daily average
Byproduct:								
January	2,796,800	90,200	3,313,500	106,900	4,360,700	140,700	2,762,500	89,100
February	2,777,200	99,200	3,145,600	108,500	3,992,900	142,600	2,493,600	89,100
March	2,907,100	93,800	3,262,100	105,200	4,495,500	145,000	2,675,100	86,300
April	2,666,200	88,800	3,471,400	115,700	4,350,900	145,000	2,436,300	81,200
May	2,789,200	90,000	3,758,800	121,300	4,479,700	144,500	2,282,600	73,600
June	2,595,000	86,500	3,700,300	123,300	4,024,800	134,200	2,066,500	68,900
July	2,562,000	82,600	3,723,200	120,100	4,423,900	142,700	2,176,600	70,200
August	2,773,600	89,400	3,871,400	124,900	4,573,400	147,500	2,494,500	80,500
September	2,832,700	94,400	3,836,800	127,900	4,427,800	147,600	2,675,100	89,200
October	3,048,300	98,300	4,077,200	131,500	4,035,100	130,200	3,092,800	99,800
November	3,112,100	103,700	4,054,400	135,100	3,222,300	107,400	3,277,500	109,300
December	3,363,900	108,500	4,354,400	140,500	2,823,800	91,100	3,362,800	108,500
	34,224,100	93,800	44,569,100	121,700	49,210,800	134,800	31,795,900	87,100
Beehive:								
January	86,900	3,200	133,300	4,900	274,300	10,600	114,100	4,400
February	90,700	3,800	144,500	5,800	294,600	12,300	102,200	4,300
March	99,200	3,800	103,000	4,000	357,300	13,200	95,200	3,500
April	65,100	2,500	85,200	3,300	309,700	11,900	73,100	2,800
May	54,900	2,000	80,600	3,100	326,500	12,600	56,700	2,200
June	58,600	2,300	87,300	3,400	274,800	10,600	49,800	1,900
July	44,600	1,700	104,200	4,000	285,100	11,000	42,000	1,700
August	54,500	2,000	120,300	4,600	259,000	10,000	47,700	1,800
September	55,500	2,200	153,900	5,900	253,900	9,800	53,600	2,100
October	88,900	3,300	222,700	8,200	225,500	8,700	60,700	2,300
November	99,800	3,800	225,800	9,000	168,800	6,500	66,700	2,600
December	118,500	4,700	245,300	9,400	135,200	5,200	75,600	2,900
	917,200	2,900	1,706,100	5,500	3,164,700	10,200	837,400	2,700
Total coke:								
January	2,883,700	93,400	3,446,800	111,800	4,635,000	151,300	2,876,600	93,500
February	2,867,900	103,000	3,290,100	114,300	4,287,500	154,900	2,595,800	93,400
March	3,006,300	97,600	3,365,100	109,200	4,852,800	158,200	2,770,300	89,800
April	2,731,300	91,300	3,556,600	119,000	4,660,600	156,900	2,509,400	84,000
May	2,844,100	92,000	3,839,400	124,400	4,806,200	157,100	2,339,300	75,800
June	2,653,600	88,800	3,787,600	126,700	4,299,600	144,800	2,116,300	70,800
July	2,606,600	84,300	3,827,400	124,100	4,709,000	153,700	2,218,600	71,900
August	2,828,100	91,400	3,991,700	129,500	4,832,400	157,500	2,542,200	82,300
September	2,888,200	96,600	3,990,700	133,800	4,681,700	157,400	2,728,700	91,300
October	3,137,200	101,600	4,299,900	139,700	4,260,600	138,900	3,153,500	102,100
November	3,211,900	107,500	4,280,200	144,100	3,391,100	113,900	3,344,200	111,900
December	3,482,400	113,200	4,599,700	149,900	2,959,000	96,300	3,438,400	111,400
	35,141,300	96,700	46,275,200	127,200	52,375,500	145,000	32,633,300	89,800

[1] Subject to revision.

TABLE 4.—*Beehive coke produced in the United States, 1937–38, by weeks*

[Estimated from railroad shipments]

1937

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1-2 [1]	19,900	May 15	83,000	Sept. 25	60,000
Jan. 9	62,900	May 22	74,600	Oct. 2	56,700
Jan. 16	62,400	May 29	68,900	Oct. 9	51,600
Jan. 23	63,700	June 5	62,300	Oct. 16	57,200
Jan. 30	63,800	June 12	64,200	Oct. 23	52,900
Feb. 6	66,400	June 19	61,500	Oct. 30	47,000
Feb. 13	69,900	June 26	65,800	Nov. 6	45,600
Feb. 20	77,200	July 3	63,500	Nov. 13	41,400
Feb. 27	79,500	July 10	63,000	Nov. 20	38,000
Mar. 6	79,500	July 17	64,000	Nov. 27	33,800
Mar. 13	82,900	July 24	66,100	Dec. 4	35,700
Mar. 20	74,600	July 31	61,000	Dec. 11	31,200
Mar. 27	89,100	Aug. 7	58,200	Dec. 18	32,100
Apr. 3	59,300	Aug. 14	61,300	Dec. 25	27,900
Apr. 10	63,600	Aug. 21	62,300	Dec. 27-31 [2]	21,100
Apr. 17	72,100	Aug. 28	58,000		
Apr. 24	80,500	Sept. 4	59,200		3,164,700
May 1	73,700	Sept. 11	59,400		
May 8	76,600	Sept. 18	58,600		

1938

Week ended—	Net tons	Week ended—	Net tons	Week ended—	Net tons
Jan. 1 [3]	4,000	May 14	15,100	Sept. 24	12,500
Jan. 8	25,400	May 21	12,100	Oct. 1	13,800
Jan. 15	26,100	May 28	10,500	Oct. 8	14,600
Jan. 22	27,700	June 4	11,400	Oct. 15	14,700
Jan. 29	25,800	June 11	11,500	Oct. 22	13,700
Feb. 5	26,700	June 18	13,400	Oct. 29	13,400
Feb. 12	26,300	June 25	11,000	Nov. 5	14,500
Feb. 19	24,200	July 2	9,900	Nov. 12	13,300
Feb. 26	24,600	July 9	10,000	Nov. 19	17,300
Mar. 5	23,300	July 16	10,200	Nov. 26	16,000
Mar. 12	20,700	July 23	9,700	Dec. 3	18,700
Mar. 19	22,800	July 30	9,100	Dec. 10	17,800
Mar. 26	19,400	Aug. 6	11,300	Dec. 17	16,000
Apr. 2	17,500	Aug. 13	10,400	Dec. 24	16,000
Apr. 9	15,500	Aug. 20	10,700	Dec. 31	17,000
Apr. 16	17,800	Aug. 27	10,800		
Apr. 23	16,400	Sept. 3	10,400		837,400
Apr. 30	16,700	Sept. 10	11,400		
May 7	15,000	Sept. 17	13,300		

[1] 2 days only. [2] 5 days only. [3] 1 day only.

TABLE 5.—*Byproduct coke produced in the United States in 1937, by months and States, in net tons* [1]

[Based on reports from all producers]

State	January	February	March	April	May	June	July
Alabama	332,400	312,800	367,500	338,600	361,000	354,000	368,700
Colorado	42,300	34,900	38,200	43,000	55,500	53,700	49,200
Illinois	243,000	232,500	267,800	259,400	260,000	237,700	263,200
Indiana	532,300	502,200	566,600	507,600	519,500	439,700	504,000
Maryland	127,700	132,000	140,200	138,000	135,700	134,900	137,900
Massachusetts	101,600	85,500	97,300	94,700	98,000	91,000	88,600
Michigan	187,300	169,000	202,900	130,500	163,300	205,400	207,800
Minnesota	72,600	64,400	66,700	62,800	64,700	56,800	54,200
New Jersey	85,400	76,600	86,300	84,400	88,200	83,900	85,500
New York	420,100	385,500	428,900	419,000	438,200	418,900	423,000
Ohio	576,800	531,100	640,200	648,200	640,100	376,300	613,600
Pennsylvania	1,314,400	1,189,400	1,256,200	1,290,700	1,311,400	1,237,900	1,277,300
Tennessee	7,100	7,600	8,800	8,700	8,600	6,800	6,900
Utah	13,000	11,700	12,500	12,100	12,200	14,800	16,700
Washington	2,300	1,900	1,900	2,000	1,700	1,500	1,400
West Virginia	149,400	140,000	161,400	153,000	158,200	151,600	158,000
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	153,000	115,800	152,100	158,200	163,400	159,900	167,900
Total production	4,360,700	3,992,900	4,495,500	4,350,900	4,479,700	4,024,800	4,423,900
At merchant plants	1,119,100	996,400	1,140,500	1,040,600	1,104,100	1,107,300	1,107,800
At furnace plants	3,241,600	2,996,500	3,355,000	3,310,300	3,375,600	2,917,500	3,316,100

[1] Figures for 1938 not yet available.

TABLE 5—*Byproduct coke produced in the United States in 1937, by months and States, in net tons*—Continued.

State	August	September	October	November	December	Total
Alabama	386, 800	372, 100	387, 300	346, 000	332, 600	4, 259, 800
Colorado	46, 800	43, 500	29, 300	33, 000	17, 600	487, 000
Illinois	286, 000	270, 600	245, 600	219, 200	213, 800	2, 998, 800
Indiana	512, 700	504, 800	395, 000	264, 900	217, 700	5, 467, 000
Maryland	135, 800	131, 500	118, 200	95, 600	86, 200	1, 513, 700
Massachusetts	88, 200	91, 800	99, 600	94, 700	99, 600	1, 130, 600
Michigan	208, 400	203, 500	212, 400	207, 800	185, 200	2, 283, 500
Minnesota	54, 800	55, 300	54, 900	48, 600	48, 800	704, 600
New Jersey	86, 400	83, 600	85, 200	83, 200	86, 300	1, 015, 000
New York	426, 300	417, 700	441, 200	377, 900	350, 300	4, 947, 000
Ohio	690, 600	657, 800	608, 600	424, 800	329, 800	6, 737, 900
Pennsylvania	1, 297, 400	1, 248, 900	1, 009, 800	709, 500	558, 300	13, 701, 200
Tennessee	6, 900	6, 900	7, 100	6, 900	7, 100	89, 400
Utah	14, 900	14, 000	6, 200	6, 400	15, 200	149, 700
Washington	1, 300	700				14, 700
West Virginia	162, 600	159, 900	165, 800	141, 000	117, 100	1, 818, 000
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	167, 500	165, 200	168, 900	162, 800	158, 200	1, 892, 900
Total production	4, 573, 400	4, 427, 800	4, 035, 100	3, 222, 300	2, 823, 800	49, 210, 800
At merchant plants	1, 104, 100	1, 093, 100	1, 124, 600	1, 079, 600	1, 059, 400	13, 076, 600
At furnace plants	3, 469, 300	3, 334, 700	2, 910, 500	2, 142, 700	1, 764, 400	36, 134, 200

TABLE 6.—*Beehive coke produced in the United States, 1937–38, by months and States, in net tons*

[Based on railroad shipments]

State	January	February	March	April	May	June	July
1937							
Colorado	6, 600	4, 300	6, 500	4, 600	5, 600	4, 900	4, 000
Pennsylvania	230, 300	247, 600	293, 800	271, 200	268, 700	226, 200	231, 000
Tennessee	600	1, 100	2, 100	1, 100	1, 600	1, 300	1, 400
Utah	100	100	200	200	300	600	900
Virginia	16, 100	18, 400	26, 100	7, 300	25, 200	25, 400	23, 400
West Virginia	20, 600	23, 100	28, 600	25, 300	25, 100	16, 400	24, 400
	274, 300	294, 600	357, 300	309, 700	326, 500	274, 800	285, 100
1938							
Colorado	4, 900	4, 200	5, 200	4, 500	4, 700	4, 000	3, 200
Pennsylvania	78, 400	68, 700	63, 000	46, 000	29, 700	21, 900	18, 000
Tennessee	500	700	400	300	200	200	400
Utah	1, 400	900	500	400	400	500	300
Virginia	11, 200	9, 200	9, 000	7, 500	5, 100	8, 700	11, 400
West Virginia	17, 700	18, 500	17, 100	14, 400	16, 600	14, 500	8, 700
	114, 100	102, 200	95, 200	73, 100	56, 700	49, 800	42, 000

State	August	September	October	November	December	Total
1937						
Colorado	3, 600	4, 600	6, 600	7, 200	5, 700	64, 200
Pennsylvania	211, 400	203, 000	166, 300	119, 700	89, 800	2, 559, 000
Tennessee	1, 500	1, 400	1, 700	700	500	15, 000
Utah	800	600	1, 000	900	1, 000	6, 700
Virginia	18, 800	19, 400	24, 200	18, 500	17, 600	240, 400
West Virginia	22, 900	24, 900	25, 700	21, 800	20, 600	279, 400
	259, 000	253, 900	225, 500	168, 800	135, 200	3, 164, 700
1938						
Colorado	2, 700	2, 200	3, 000	7, 400	8, 700	54, 700
Pennsylvania	18, 000	25, 200	32, 100	36, 800	44, 300	482, 100
Tennessee	700	600	700	500	300	5, 500
Utah	600	600	900	800	400	7, 700
Virginia	14, 200	13, 300	13, 500	14, 100	16, 700	133, 900
West Virginia	11, 500	11, 700	10, 500	7, 100	5, 200	153, 500
	47, 700	53, 600	60, 700	66, 700	75, 600	837, 400

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 the bulk 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 a position of little significance in the coke industry (in 1938 supplying only 2.6 percent of the total production) the statistics presented in the two following tables cover byproduct coke only.

A "furnace" plant is herein defined 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 1938, 43 furnace plants produced 20,679,091 tons of byproduct coke and 40 "other" plants produced 11,116,801 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 steel depression, the proportion fell to 54 percent; it rose to 73 percent in 1937 and fell again to 65 percent in 1938.

TABLE 7.—*Number and production of byproduct coke plants connected with iron furnaces and of other byproduct plants, 1913, 1918, and 1936–38*

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
1936	42	43	32,076,089	12,493,032	72.0	28.0
1937	43	42	36,134,209	13,076,539	73.4	26.6
1938 [1]	43	40	20,679,091	11,116,801	65.0	35.0

[1] Subject to revision.

TABLE 8.—*Monthly and average daily production of byproduct coke by plants associated with iron furnaces and by all other plants, 1936–38, in net tons*

Month	1936 Furnace plants	1936 Other plants	1937 Furnace plants	1937 Other plants	1938 [1] Furnace plants	1938 [1] Other plants
Monthly production:						
January	2, 294, 400	1, 019, 100	3, 241, 600	1, 119, 100	1, 711, 700	1, 050, 800
February	2, 173, 300	972, 300	2, 996, 500	996, 400	1, 544, 800	948, 800
March	2, 250, 700	1, 011, 400	3, 355, 000	1, 140, 500	1, 673, 100	1, 002, 000
April	2, 483, 200	988, 200	3, 310, 300	1, 040, 600	1, 494, 600	941, 700
May	2, 724, 600	1, 034, 200	3, 375, 600	1, 104, 100	1, 375, 400	907, 200
June	2, 697, 300	1, 003, 000	2, 917, 500	1, 107, 300	1, 225, 000	841, 500
July	2, 703, 000	1, 020, 200	3, 316, 100	1, 107, 800	1, 351, 300	825, 300
August	2, 827, 100	1, 044, 300	3, 469, 300	1, 104, 100	1, 646, 600	847, 900
September	2, 795, 300	1, 041, 500	3, 334, 700	1, 093, 100	1, 798, 800	876, 300
October	2, 976, 100	1, 101, 100	2, 910, 500	1, 124, 600	2, 139, 000	953, 800
November	2, 958, 900	1, 095, 500	2, 142, 700	1, 079, 600	2, 339, 400	938, 100
December	3, 192, 200	1, 162, 200	1, 764, 400	1, 059, 400	2, 379, 400	983, 400
	32, 076, 100	12, 493, 000	36, 134, 200	13, 076, 600	20, 679, 100	11, 116, 800
Average daily production:						
January	74, 000	32, 900	104, 600	36, 100	55, 200	33, 900
February	75, 000	33, 500	107, 000	35, 600	55, 200	33, 900
March	72, 600	32, 600	108, 200	36, 800	54, 000	32, 300
April	82, 800	32, 900	110, 300	34, 700	49, 800	31, 400
May	87, 900	33, 400	108, 900	35, 600	44, 400	29, 200
June	89, 900	33, 400	97, 300	36, 900	40, 800	28, 100
July	87, 200	32, 900	107, 000	35, 700	43, 600	26, 600
August	91, 200	33, 700	111, 900	35, 600	53, 100	27, 400
September	93, 200	34, 700	111, 200	36, 400	60, 000	29, 200
October	96, 000	35, 500	93, 900	36, 300	69, 000	30, 800
November	98, 600	36, 500	71, 400	36, 000	78, 000	31, 300
December	103, 000	37, 500	56, 900	34, 200	76, 800	31, 700
Average	87, 600	34, 100	99, 000	35, 800	56, 700	30, 400

[1] Subject to revision.

PRODUCTION BY STATES AND DISTRICTS

All 21 States that produced byproduct coke in 1938 shared the decreased output, the percentage of decrease being higher in those States dominated by furnace interests. Thus, Colorado showed the highest relative decrease—61 percent—followed by Pennsylvania with a decline of 48 percent, Indiana with 47 percent, Ohio with 45 percent, and Illinois with 42 percent. Other rates of decrease ranged from 0.2 percent in Massachusetts (a "merchant" State) to 27 percent in Maryland.

In rank of producing importance the position of Pennsylvania remains unchallenged. In 1938 the State contributed 22 percent of the byproduct coke total, 58 percent of the beehive, and 23 percent of all coke produced in the United States. Not only is Pennsylvania the principal coke-producing State, but large quantities of her celebrated coking coals are shipped annually to other States for use in byproduct ovens. The famous Pittsburgh bed, underlying the Pittsburgh, Connellsville, and adjacent fields, is probably the largest repository of high-grade coking coal in the world.

TABLE 9.—*Summary of coke produced, value, number of ovens, coal charged, and average yield in 1937, by States* [1]

[Exclusive of screenings or breeze]

State	Byproduct						
	Plants in existance	Ovens in existance	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
Alabama	8	1,254	5,886,198	72.37	4,259,771	$13,275,098	$3.12
Colorado	1	149	722,865	67.36	486,945	(2)	(2)
Connecticut	1	61	(3)	(3)	(3)	(3)	(3)
Illinois	8	896	4,251,016	70.54	2,998,663	20,213,129	6.74
Indiana	6	1,607	7,588,989	72.04	5,467,061	32,655,355	5.97
Kentucky	1	108	(3)	(3)	(3)	(3)	(3)
Maryland	1	361	2,084,471	72.62	1,513,651	(2)	(2)
Massachusetts	2	215	1,615,444	69.99	1,130,620	(2)	(2)
Michigan	9	676	3,213,934	71.05	2,283,518	13,816,401	6.05
Minnesota	3	196	1,002,812	70.27	704,631	5,611,287	7.96
Missouri	1	64	(3)	(3)	(3)	(3)	(3)
New Jersey	2	239	1,434,022	70.78	1,015,073	(2)	(2)
New York	8	978	6,894,332	71.75	4,946,964	29,853,516	6.03
Ohio	15	1,839	9,409,187	71.61	6,737,881	32,185,945	4.78
Pennsylvania	12	3,348	19,907,104	68.83	13,701,262	55,142,252	4.02
Rhode Island	1	65	(3)	(3)	(3)	(3)	(3)
Tennessee	1	24	129,635	69.00	89,451	432,943	4.84
Utah	1	56	264,070	56.67	149,659	(2)	(2)
Virginia							
Washington		(4)	26,118	56.11	14,656	87,936	6.00
West Virginia	4	387	2,572,329	70.67	1,817,993	5,822,004	3.20
Wisconsin	2	195	(3)	(3)	(3)	(3)	(3)
Combined States			2,572,847	73.57	1,892,949	13,628,440	7.20
Undistributed						24,631,446	5.73
Grand total: 1937	87	12,718	69,575,373	70.73	49,210,748	247,355,752	5.03
1936	90	12,849	63,243,517	70.47	44,569,121	225,695,719	5.06
Change in 1937, percent	−3.3	−1.0	+10.0	+0.4	+10.4	+9.6	−0.6

See footnotes at end of table.

TABLE 9.—*Summary of coke produced, value, number of ovens, coal charged, and average yield in 1937, by States*—Continued

State	Beehive						Total	
	Ovens in existance	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		
Alabama							4,259,771	$13,275,098
Colorado	188	115,278	55.71	64,222	(2)	(2)	551,167	(2)
Connecticut							(3)	(3)
Illinois							2,998,663	20,213,129
Indiana							5,467,061	32,655,355
Kentucky							(3)	(3)
Maryland							1,513,651	(2)
Massachusetts							1,130,620	(2)
Michigan							2,283,518	13,816,401
Minnesota							704,631	5,611,287
Missouri							(3)	(3)
New Jersey							1,015,073	(2)
New York							4,946,964	29,853,516
Ohio							6,737,881	32,185,945
Pennsylvania	8,239	3,906,754	65.50	2,559,048	$10,699,200	$4.18	16,260,310	65,841,452
Rhode Island							(3)	(3)
Tennessee	140	27,803	53.89	14,982	86,134	5.75	104,433	519,077
Utah	819	12,271	54.25	6,657	(2)	(2)	156,316	(2)
Virginia	1,291	412,192	58.33	240,425	1,180,800	4.91	240,425	1,180,800
Washington	58						14,656	87,936
West Virginia	1,459	452,526	61.74	279,387	1,232,182	4.41	2,097,380	7,054,186
Wisconsin							(3)	(3)
Combined States							1,892,949	13,628,440
Undistributed					449,835	6.35		25,081,281
Grand total:								
1937	12,194	4,926,824	64.23	3,164,721	13,648,151	4.31	52,375,469	261,003,903
1936	13,012	2,698,158	63.23	1,706,063	6,678,272	3.91	46,275,184	232,373,991
Change in 1937, percent	−6.3	+82.6	+1.6	+85.5	+104.4	+10.2	+13.2	+12.3

[1] Figures for 1938 not yet available.
[2] Included under "Undistributed."
[3] Included under "Combined States."
[4] 20 ovens operated from January to November, after which plant was abandoned.

TABLE 10.—*Byproduct and beehive coke produced, by States, 1918 and 1935–38, in net tons*

State	1918	1935	1936	1937	1938 [1]
Byproduct:					
Alabama	2,634,451	1,994,220	3,089,622	4,259,771	3,374,898
Colorado	230,663	206,901	337,341	486,945	191,839
Connecticut		(2)	(2)	(2)	(2)
Illinois	2,285,610	1,668,523	2,082,516	2,998,663	1,738,106
Indiana	3,898,215	3,768,480	5,449,755	5,467,061	2,894,548
Kentucky	517,749	(2)	(2)	(2)	(2)
Maryland	474,368	929,617	1,217,039	1,513,651	1,105,262
Massachusetts	556,397	1,006,115	1,108,219	1,130,620	1,128,612
Michigan	(2)	2,482,302	2,293,653	2,283,518	1,751,781
Minnesota	784,065	430,082	521,518	704,631	540,447
Missouri	(2)	(2)	(2)	(2)	(2)
New Jersey	682,148	917,117	1,007,500	1,015,073	1,002,305
New York	1,069,587	4,099,242	4,835,921	4,946,964	3,948,833
Ohio	5,226,334	5,100,987	6,242,300	6,737,881	3,703,819
Pennsylvania	4,586,981	8,078,175	12,570,816	13,701,262	7,124,694
Rhode Island		(2)	(2)	(2)	(2)
Tennessee	124,469	78,668	83,305	89,451	75,906
Utah		115,282	124,346	149,659	133,927
Washington	30,129	28,744	28,368	14,656	
West Virginia	603,393	1,603,584	1,702,792	1,817,993	1,360,375
Wisconsin	(2)	(2)	(2)	(2)	(2)
Combined States	2,293,021	1,716,014	1,874,110	1,892,949	1,720,540
	25,997,580	34,224,053	44,569,121	49,210,748	31,795,892

See footnotes at end of table.

TABLE 10.—*Byproduct and beehive coke produced, by States, 1918 and 1935–38, in net tons*—Continued

State	1918	1935	1936	1937	1938 [1]
Beehive:					
Alabama	1,717,721				
Colorado	758,784	49,209	61,293	64,222	54,721
Georgia	22,048				
Kentucky	301,036				
New Mexico	597,072				
Ohio	138,909				
Oklahoma	(2)				
Pennsylvania	22,136,664	564,052	1,213,294	2,559,048	482,105
Tennessee	302,637	3,099	3,567	14,982	5,500
Utah	(2)	5,575	5,617	6,657	7,668
Virginia	1,234,256	137,587	191,331	240,425	133,905
Washington	93,659	2,475	312		
West Virginia	2,716,613	155,211	230,649	279,387	153,513
Combined States	461,393				
	30,480,792	917,208	1,706,063	3,164,721	837,412
Grand total	56,478,372	35,141,261	46,275,184	52,375,469	32,633,304

[1] Figures for byproduct subject to revision.
[2] Included under "Combined States."

TABLE 11.—*Byproduct and beehive coke produced in Pennsylvania in 1937, by districts* [1]

[Number of plants and ovens includes those idle during the year; no new ovens were under construction in 1937]

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
Byproduct:							
Eastern Pennsylvania [2]	5	734	3,265,323	69.73	2,277,035	$14,065,111	$6.18
Western Pennsylvania [3]	7	2,614	16,641,781	68.65	11,424,227	41,077,141	3.60
	12	3,348	19,907,104	68.83	13,701,262	55,142,252	4.02
Beehive:							
Allegheny Mountain and Allegheny Valley	2	242	64,103	57.04	36,567	183,497	5.02
Connellsville	20	2,983	1,355,627	66.15	896,749	3,593,349	4.01
Lower Connellsville	18	3,001	1,659,105	66.09	1,096,426	4,427,136	4.04
Upper Connellsville	5	728	215,112	66.89	143,896	656,485	4.56
Pittsburgh and other districts [4]	6	1,285	612,807	62.89	385,410	1,838,733	4.77
	51	8,239	3,906,754	65.50	2,559,048	10,699,200	4.18
Grand total	63	11,587	23,813,858	68.28	16,260,310	65,841,452	4.05

[1] Figures for 1938 not yet available.
[2] Includes plants at Bethlehem, Chester, Philadelphia, Steelton, and Swedeland.
[3] Includes plants at Aliquippa, Clairton, Erie, Johnstown, Midland, Neville Island, and Pittsburgh.
[4] Includes Bedford and parts of Indiana and Westmoreland Counties.

TABLE 12.—*Byproduct coke produced in Ohio in 1937, by districts* [1]

District	Plants	Ovens [2]	Coal used (net tons)	Yield of coke from coal (percent)	Coke produced (net tons)	Value of coke at ovens	
						Total	Per ton
Canton, Cleveland, and Massillon	5	595	2,790,415	72.29	2,017,183	$9,735,347	$4.83
Youngstown	3	594	2,460,762	69.10	1,700,441	7,757,765	4.56
Other districts [3]	7	650	4,158,010	72.64	3,020,257	14,692,833	4.86
Total: 1937	15	1,839	9,409,187	71.61	6,737,881	32,185,945	4.78
1936	15	1,839	8,760,708	71.25	6,242,300	26,938,007	4.32
Change in 1937 percent			+7.4	+0.5	+7.9	+19.5	+10.6

[1] Figures for 1938 not yet available.
[2] In addition 15 ovens were under construction at the close of 1937.
[3] Includes plants at Hamilton, Ironton, Lorain, Painesville, Portsmouth, Toledo, and Warren.

NUMBER AND TYPE OF OVENS

In the byproduct branch of the coke industry 202 new byproduct ovens were completed and put into operation during 1938; of these 41 were in Colorado, 12 in Kentucky, 65 in Michigan, and 84 in Ohio. One new furnace plant was added to the active list, operations beginning in October 1938. At the close of the year 126 ovens still were under construction, and 182 had been abandoned, the total in existence at the 88 plants being about 12,650. Four of the 88 plants were idle throughout the year, 7 were out of blast at the close of December, and a few others operated on a part-time basis.

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 1938, only 10,816 remained. Byproduct ovens during the same period rose from 4,078 in 1910 to 10,881 in 1920, and to 12,831 in 1930, but dropped to 12,650 in 1938, the net change during the past 8 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 72 beehive coke plants in existence at the close of 1938 comprised 10,816 ovens. However, only 38 plants with a total of 5,453 ovens were active. In 1938, for the first time, the Bureau of Mines asked beehive operators to report the average number of ovens active during each month of 1938. Responses to this inquiry indicate that the highest number operating in any month (January) was 2,729 ovens and the lowest (October) was 1,519—an unweighted average for the year of 1,846 ovens.

TABLE 13.—*Coke ovens completed and abandoned in 1937 and total number in existence at end of year, by States* [1]

State	Plants in existence Dec. 31	Ovens: In existence Dec. 31: Number	Ovens: In existence Dec. 31: Capacity per day (net tons of coke)	Ovens: New: Number	Ovens: New: Capacity per day (net tons of coke)	Ovens: Abandoned during year	Ovens: Under construction Dec. 31: Number	Ovens: Under construction Dec. 31: Capacity per day (net tons of coke)
Byproduct:								
Alabama	8	1,254	14,766	[2] 184	[2] 2,621	140		
Colorado	1	149	2,233			2	41	710
Connecticut	1	61	(3)					
Illinois	8	896	12,382					
Indiana	6	1,607	22,118	[4] 197	[4] 2,359			
Kentucky	1	108	(3)				12	(3)
Maryland	1	361	5,088					
Massachusetts	2	215	3,553			215		
Michigan	9	676	7,472	122	2,030	60	191	3,565
Minnesota	3	196	2,572					
Missouri	1	64	(3)					
New Jersey	2	239	2,750					
New York	8	978	14,859			46		
Ohio	15	1,839	24,957				15	(3)
Pennsylvania	12	3,348	46,058					
Rhode Island	1	65	(3)					
Tennessee	1	24	350					
Utah	1	56	705					
Washington						[5] 20		
West Virginia	4	387	5,511	25	420			
Wisconsin	2	195	(3)					
Undistributed			6,481					422
Total byproduct	87	12,718	171,855	528	7,430	483	259	4,697
At merchant plants	42	3,419	43,101	25	420	281	12	4,697
At furnace plants	45	9,299	128,754	503	7,010	202	247	
Beehive:								
Colorado	2	188						
Pennsylvania	51	8,239		[6] 994	(7)	749		
Tennessee	2	140		[6] 15	(7)			
Utah	1	819						
Virginia	7	1,291	(7)	[6] 28	(7)			
Washington	1	58						
West Virginia	9	1,459		[6] 88	(7)			
Total beehive	73	12,194		1,125	(7)	749		

[1] Figures for 1938 not yet available.
[2] Includes 38 new ovens, 421 tons capacity, replacing old ovens that were rebuilt.
[3] Included under "Undistributed."
[4] Includes 138 new ovens, 1,559 tons capacity, replacing old ovens that were rebuilt.
[5] Abandoned after producing.
[6] All old ovens rebuilt or repaired, some of which were reported abandoned in previous years.
[7] Data not available.

TABLE 14.—*Beehive ovens active in 1938, by months*

Month	Number	Month	Number	Month	Number
January	2,729	May	1,664	September	1,711
February	2,419	June	1,590	October	1,519
March	2,119	July	1,548	November	1,702
April	1,869	August	1,624	December	1,655

TABLE 15.—*Byproduct ovens of each type at end of 1937, by States* [1]

State	Koppers [2]	Semet-Solvay	Wilputte	Cambria	Roberts Morrissey	American Foundation	All others [3]	Tota
Alabama	774	420	60					1,254
Colorado	149							149
Connecticut	61							61
Illinois	662	120	88				26	896
Indiana	1,186	161	260					1,607
Kentucky		108						108
Maryland	361							361
Massachusetts	160		55					215
Michigan	253	216	120				87	676
Minnesota	196							196
Missouri	56						8	64
New Jersey	239							239
New York	743	180				55		978
Ohio	1,546	293						1,839
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
Total	9,956	1,690	751	120	25	55	121	12,718
At merchant plants	1,938	1,034	246		25	55	121	3,419
At furnace plants	8,018	656	505	120				9,299

[1] Figures for 1938 not yet available.
[2] Includes the Koppers-Becker type.
[3] Includes 26 Curran-Knowles, 27 Parker-Russell, 60 Improved Equipment Co., and 8 Piette ovens.

CAPACITY OF BYPRODUCT OVENS

The reported maximum capacity of the byproduct ovens in existence is seldom if ever 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 high radiation losses occur after that period; other claims have been made that ovens built 25 years ago still are capable of efficient operation. Had it not been for the depression years much replacement building would have been done. The closing down 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, 1938, was 174,690 tons, an increase of about 1.6 percent compared with that reported for 87 plants at the end of 1937. The daily capacity at the 42 merchant plants was 43,290 tons, an average of 1,031 tons per plant, while at the 46 furnace plants the capacity was 131,400 tons (2,857 tons per plant), the furnace plants as a rule carrying larger batteries of ovens.

Production of byproduct coke in 1938 was 51 percent of the calculated capacity of all by product ovens compared with 79 percent in 1937 and 91 percent in the peak year 1929. Furnace plants operated at only 44 percent of capacity, while merchant plants operated at 71 percent.

TABLE 16.—*Estimated annual potential production of coke and coal required for charge of byproduct coke ovens in the United States, 1936–37, when operated at different percentages of maximum capacity, in millions of net tons* [1]

Percent of maximum capacity	1936				1937			
	Ovens completed Dec. 31		Including ovens under construction		Ovens completed Dec. 31		Including ovens under construction	
	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]	Coke	Coal [2]
100	62.2	88.9	64.3	91.9	62.7	89.6	64.4	92.0
90	56.0	80.0	57.9	82.7	56.4	80.6	58.0	82.8
85	52.9	75.6	54.7	78.1	53.3	76.2	54.7	78.2
75	46.7	66.7	48.2	68.9	47.0	67.2	48.3	69.0
50	31.1	44.5	32.2	46.0	31.4	44.8	32.2	46.0

[1] Figures for 1938 not yet available.
[2] Coal for charge estimated on basis of 70-percent yield in coke.

TABLE 17.—*Relation (percent) of production to maximum capacity at byproduct coke plants, 1929 and 1935–38, by months*

Month	1929	1935	1936	1937	1938	Month	1929	1935	1936	1937	1938
January	88.6	52.5	62.4	83.0	52.4	August	93.6	52.1	74.2	86.0	47.3
February	91.3	57.7	63.3	83.5	52.3	September	91.9	55.0	76.0	86.1	52.4
March	93.0	54.6	61.5	84.9	50.7	October	92.3	57.2	78.1	76.0	57.9
April	92.8	51.7	67.6	84.9	47.7	November	89.0	60.3	80.3	62.8	63.3
May	94.0	52.4	70.8	84.6	43.2	December	83.1	63.1	83.4	53.1	62.8
June	93.9	50.4	72.1	78.6	40.4						
July	93.0	48.2	71.5	83.2	41.3	The year	91.4	54.6	71.6	78.8	51.0

QUANTITY AND COST OF COAL CHARGED

Although the quantity of coal used in the manufacture of coke has fluctuated widely in the past decade the proportion of total output of bituminous coal carbonized each year has remained remarkably constant, ranging from 10.3 to 16.2 percent, with an average of 13.7 percent, for the 5-year period 1929–33, inclusive, and from 12.8 to 16.8 percent, with an average of 14.5 percent, for 1934–38. In 1938 the proportion fell slightly below the average for the 10-year period (14.1 percent). In that year coke ovens consumed 46,352,700 tons or only 13.5 percent of the total output of bituminous coal. Of this quantity 44,992,800 tons were used in byproduct ovens.

The cost of coal constitutes the chief item of expense in the manufacture of coke. In 1937 the cost of raw coal f. o. b. ovens ranged from $1.86 in Virginia, where all the coke is made in beehive ovens at the mines, to $5.24 in Minnesota, where the cost includes heavy freight charges from distant mines.

The average cost of coal in byproduct ovens in 1937 was $3.74 a ton, and the cost of the coal equivalent of 1 ton of merchantable coke was $5.27. The corresponding figures for beehive coke were $2.01 and $3.14, respectively. In 1938 the cost of the coal consumed at beehive ovens had risen to $2.05, and the cost of the coal equivalent per ton of coke rose in turn to $3.32.

The Bureau of Mines has been determining the expanding properties of coal, particularly of samples received in connection with the survey of gas- and coke-making properties of American coals. A recent report of investigations on the expansion of coal during coking [2] will be of value to readers interested in the technology of the coke industry.

TABLE 18.—*Coal consumed in coke ovens, 1936–38, by months, in net tons*

[For figures, 1912-30, inclusive, see Coke and Byproducts in 1928, pp. 731-733, and Coke and Byproducts in 1930, p. 514]

Month	1936			1937			1938 [1]		
	Byproduct	Beehive	Total	Byproduct	Beehive	Total	Byproduct	Beehive	Total
January	4,710,400	209,900	4,920,300	6,198,700	426,600	6,625,300	3,922,600	184,400	4,107,000
February	4,470,100	227,600	4,697,700	5,679,900	458,500	6,138,400	3,539,200	164,700	3,703,900
March	4,634,500	162,300	4,796,800	6,387,000	556,800	6,943,800	3,795,000	153,200	3,948,200
April	4,935,800	134,100	5,069,900	6,183,800	480,800	6,664,600	3,456,500	117,600	3,574,100
May	5,346,100	126,900	5,473,000	6,368,500	509,700	6,878,200	3,235,800	92,000	3,327,800
June	5,263,900	137,600	5,401,500	5,729,200	430,500	6,159,700	2,930,800	81,500	3,012,300
July	5,271,100	165,200	5,436,300	6,217,200	441,700	6,658,900	3,085,200	68,700	3,153,900
August	5,484,200	190,700	5,674,900	6,425,800	401,100	6,826,900	3,534,100	78,900	3,613,000
September	5,435,700	244,000	5,679,700	6,220,700	392,800	6,613,500	3,769,700	87,700	3,857,400
October	5,777,100	353,100	6,130,200	5,664,800	351,600	6,016,400	4,360,200	99,700	4,459,900
November	5,744,300	357,900	6,102,200	4,527,000	264,000	4,791,000	4,622,100	109,100	4,731,200
December	6,170,300	388,900	6,559,200	3,972,800	212,700	4,185,500	4,741,600	122,400	4,864,000
	63,243,500	2,698,200	65,941,700	69,575,400	4,926,800	74,502,200	44,992,800	1,359,900	46,352,700

[1] Subject to revision.

TABLE 19.—*Total quantity and value at ovens of coal used in manufacture of coke, by States, in 1937* [1]

State	Coal used (net tons)	Cost of coal		Coal per ton of coke	
		Total	Per ton of coal	Net tons	Cost
Byproduct plants:					
Alabama	5,886,198	$13,692,329	$2.33	1.38	$3.22
Colorado	722,865	(2)	(2)	1.48	(2)
Illinois	4,251,016	19,654,569	4.62	1.42	6.56
Indiana	7,588,989	35,716,558	4.71	1.39	6.55
Maryland	2,084,471	(2)	(2)	1.38	(2)
Massachusetts	1,615,444	(2)	(2)	1.43	(2)
Michigan	3,213,934	13,379,059	4.16	1.41	5.87
Minnesota	1,002,812	5,256,607	5.24	1.42	7.44
New Jersey	1,434,022	(2)	(2)	1.41	(2)
New York	6,894,332	31,397,888	4.55	1.39	6.32
Ohio	9,409,187	35,398,011	3.76	1.40	5.26
Pennsylvania	19,907,104	59,342,834	2.98	1.45	4.32
Tennessee	129,635	443,939	3.42	1.45	4.96
Utah	264,070	(2)	(2)	1.76	(2)
Washington	26,118	127,258	4.87	1.78	8.67
West Virginia	2,572,329	6,530,791	2.54	1.41	3.58
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	2,572,847	11,611,196	4.51	1.36	6.13
Undistributed		27,902,659	4.56		6.48
Total byproduct	69,575,373	260,453,698	3.74	1.41	5.27
At merchant plants	18,201,810	80,027,136	4.40	1.39	6.12
At furnace plants	51,373,563	180,426,562	3.51	1.42	4.98
Beehive plants:					
Colorado and Utah	127,549	376,593	2.95	1.80	5.31
Pennsylvania	3,906,754	7,811,286	2.00	1.53	3.06
Tennessee	27,803	49,033	1.76	1.86	3.27
Virginia	412,192	767,380	1.86	1.71	3.18
West Virginia	452,526	882,124	1.95	1.62	3.16
Total beehive	4,926,824	9,886,416	2.01	1.56	3.14

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

[2] Auvil, H. S., Davis, J. D., and McCartney, J. T., Expansion of Coal During Coking: Bureau of Mines Rept. of Investigations 3451, 1939, 21 pp.

TABLE 20.—*Average cost per net ton of coal charged into byproduct coke ovens, by States, 1929 and 1934-37* [1]

State	1929	1934	1935	1936	1937	State	1929	1934	1935	1936	1937
Alabama	$2.49	$2.28	$2.37	$2.24	$2.33	Pennsylvania	$2.73	$3.04	$2.98	$2.94	$2.98
Illinois	4.29	4.49	4.62	4.43	4.62	Tennessee	3.02	3.18	3.73	3.35	3.42
Indiana	4.61	4.48	4.66	4.60	4.71	Washington	5.26	4.60	4.75	4.81	4.87
Massachusetts	4.70	4.81	5.02	4.98	(2)	West Virginia	2.41	2.07	2.20	2.37	2.54
Michigan	4.29	4.13	4.28	4.28	4.16						
Minnesota	5.04	(2)	(2)	5.28	5.24	United States average	3.50	3.70	3.82	3.69	3.74
New York	4.22	4.35	4.57	4.45	4.55						
Ohio	3.31	3.49	3.66	3.60	3.76	Cost of coal per ton of coke	5.04	5.33	5.46	5.24	5.27

[1] Figures for 1938 not yet available.
[2] Bureau of Mines not at liberty to publish data.

PREPARATION AND SOURCE OF COAL

In Alabama, Colorado, Tennessee, and Washington and certain parts of Illinois, New York, Ohio, and Pennsylvania the coal used for coking is washed before it is charged in the ovens. The washing sometimes is done by the coal operator at the mine and sometimes by the coke producer at the plant. For the country as a whole in 1937, 25 percent of the coal used in byproduct ovens and 18 percent of that in beehive ovens was washed before charging. In 1938 operators of beehive plants reported that 427,858 tons—31 percent of a total of 1,359,876 tons—were washed before coking.

TABLE 21.—*Washed and unwashed coal used in the manufacture of byproduct and beehive coke, by States in which used, in 1937, in net tons* [1]

State	Washed	Unwashed	Total
Byproduct ovens:			
Alabama	5,288,498	597,700	5,886,198
Colorado	722,865		722,865
Illinois	348,648	3,902,368	4,251,016
Indiana		7,588,989	7,588,989
Maryland		2,084,471	2,084,471
Massachusetts		1,615,444	1,615,444
Michigan		3,213,934	3,213,934
Minnesota		1,002,812	1,002,812
New Jersey		1,434,022	1,434,022
New York	942,110	5,952,222	6,894,332
Ohio	1,385,530	8,023,657	9,409,187
Pennsylvania	8,326,663	11,580,441	19,907,104
Tennessee	129,635		129,635
Utah		264,070	264,070
Washington	26,118		26,118
West Virginia	59,727	2,512,602	2,572,329
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	27,021	2,545,826	2,572,847
Total byproduct	17,256,815	52,318,558	69,575,373
At merchant plants	1,650,160	16,551,650	18,201,810
At furnace plants	15,606,655	35,766,908	51,373,563
Beehive ovens:			
Colorado	115,278		115,278
Pennsylvania	730,707	3,176,047	3,906,754
Tennessee	27,803		27,803
Utah		12,271	12,271
Virginia		412,192	412,192
Washington			
West Virginia		452,526	452,526
Total beehive	873,788	4,053,036	4,926,824

[1] Figures for 1938 not yet available.

The Appalachian fields remain the principal source of byproduct coal, although it is interesting to note that in 1937 small amounts were drawn from Illinois and Ohio. States that are not rated as producers of coking coal; and larger amounts came from the western portion of the United States (Colorado, New Mexico, Utah, and Washington). The total supplies from these four Western States amounted to 1,030,755 tons—less than 2 percent of the total.

Pennsylvania headed the list of States in volume of supplies with 43 percent of the total, followed by West Virginia with 35 percent, Kentucky with 11 percent, and Alabama with 8 percent. Other States producing coking coal supplied less than a million tons each.

TABLE 22.—*Coal used in manufacture of byproduct coke in 1937, by fields of origin, in net tons* [1]

[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
Alabama	5,802,069	Alabama.
Colorado:		
Canon, Crested Butte, and Walsen	135,155	Colorado.
Trinidad	578,420	Do.
Illinois: Franklin County	103,663	Illinois.
Kentucky:		
Eastern Kentucky:		
Elkhorn (including Hazard)	2,013,310	Indiana, New York, Ohio, Kentucky, Michigan, Missouri, New Jersey, Minnesota, and Illinois.
Harlan	3,484,375	Indiana, Illinois, Michigan, Minnesota, and New York.
Kenova-Thacker [2]	1,762,589	Michigan, Ohio, Wisconsin, Massachusetts, Minnesota, West Virginia, and Kentucky.
Miscellaneous	638,800	Indiana.
New Mexico: Raton-Trinidad	9,290	Colorado.
Ohio	503	Ohio.
Pennsylvania:		
Central Pennsylvania:		
High volatile	53,714	New York.
Medium volatile	861,641	New York and Pennsylvania.
Low volatile	1,458,864	Pennsylvania, Maryland, New York, and West Virginia.
Connellsville	15,167,424	Pennsylvania, Ohio, West Virginia, New York, Illinois, Minnesota, Michigan, and New Jersey.
Freeport	1,555,926	West Virginia, New York, Ohio, Michigan, and Pennsylvania.
Pittsburgh	9,154,109	Pennsylvania, New York, Ohio, Michigan, Illinois, Minnesota, Wisconsin, and Indiana.
Somerset	617,358	Pennsylvania, West Virginia, and Ohio.
Westmoreland	1,364,765	Pennsylvania, Maryland, and New York.
Miscellaneous	8,168	Pennsylvania.
Tennessee	110,390	Tennessee.
Utah: Carbon County	285,430	Utah.
Virginia: [2 3]		
Southwestern Virginia	281,396	New Jersey and New York.
Washington: Pierce County	22,460	Washington.
West Virginia: [2 3]		
Coal and coke [4]	150,226	Pennsylvania and Minnesota.
Kanawha and Logan (including Coal River).	8,396,995	Indiana, Illinois, Massachusetts, Ohio, New York, New Jersey, West Virginia, Connecticut, Michigan, Wisconsin, Pennsylvania, Minnesota, Rhode Island, Kentucky, and Missouri.
New River and Winding Gulf	2,114,150	Massachusetts, New York, Illinois, New Jersey, Missouri, Rhode Island, Pennsylvania, Minnesota, Kentucky, Indiana, Michigan, and Ohio.
Northern	2,827,290	Pennsylvania, Maryland, Ohio, West Virginia, Illinois, and New York.
Pocahontas [3]	10,969,509	Indiana, Ohio, Illinois, New York, Michigan, Maryland, Pennsylvania, Wisconsin, Minnesota, West Virginia, Kentucky, Connecticut, Alabama, Massachusetts, and Tennessee.
Webster-Gauley	249,988	Pennsylvania.
	70,177,977	

[1] Figures for 1938 not yet available.
[2] Tonnage from the extension of Thacker field in Virginia and West Virginia is included under Kenova-Thacker (Kentucky).
[3] Coal from the extension of the Pocahontas field in Tazwell County, Va., is included under West Virginia (Pocahontas).
[4] Includes tonnage from all of U. S. Coal Commission field 24a-b-c except Webster-Gauley.

TABLE 23.—*Source of coal used in the manufacture of byproduct coke in 1937, by States where consumed, separating merchant and furnace plants* [1]

State where coal was used	Coal produced in—												
	Alabama	Colorado	Illinois	Kentucky	New Mexico	Ohio	Pennsylvania	Tennessee	Utah	Virginia	Washington	West Virginia	Total
Alabama:													
Merchant plants	1,337,927											105,303	1,443,230
Furnace plants	4,464,142											15,056	4,479,198
Total Alabama	5,802,069											120,359	5,922,428
Colorado: Furnace plants		713,575			9,290								722,865
Illinois:													
Merchant plants			103,663	222,192			96,744					1,652,050	2,074,649
Furnace plants				854,376			395,120					1,046,206	2,295,702
Total Illinois			103,663	1,076,568			491,864					2,698,256	4,370,351
Indiana:													
Merchant plants												760,215	760,215
Furnace plants				3,409,932			20,844			339,657		3,253,770	7,024,203
Total Indiana				3,409,932			20,844			339,657		4,013,985	7,784,418
Maryland: Furnace plants							578,299					1,506,172	2,084,471
Massachusetts: Merchant plants												1,616,700	1,616,700
Michigan:													
Merchant plants				300,033			306,477			(2)		805,922	[3] 1,412,432
Furnace plants				1,208,334								307,629	1,515,963
Total Michigan				1,508,367			306,477			(2)		1,113,551	[3] 2,928,395
Minnesota:													
Merchant plants				51,558								409,707	461,265
Furnace plants				145,207			196,735					129,890	471,832
Total Minnesota				196,765			196,735					539,597	933,097
New Jersey: Merchant plants				53,293			16,390			143,339		1,264,958	1,477,980
New York:													
Merchant plants				275,040			1,933,025			138,057		1,502,819	3,848,941
Furnace plants							2,397,111					930,730	3,327,841
Total New York				275,040			4,330,136			138,057		2,433,549	7,176,782

See footnotes at end of table.

TABLE 23.—*Source of coal used in the manufacture of byproduct coke in 1937, by States where consumed, separating merchant and furnace plants.*—Continued

State where coal was used	Coal produced in—												
	Alabama	Colorado	Illinois	Kentucky	New Mexico	Ohio	Pennsylvania	Tennessee	Utah	Virginia	Washington	West Virginia	Total
Ohio:													
Merchant plants										(2)		755,882	[3] 755,882
Furnace plants				527,997		503	4,839,322					3,201,066	8,568,888
Total Ohio				527,997		503	4,839,322			(2)		3,956,948	[3] 9,324,770
Pennsylvania:													
Merchant plants							33,481					768,721	802,202
Furnace plants							17,659,965					1,428,104	19,088,069
Total Pennsylvania							17,693,446					2,196,825	19,890,271
Tennessee: Merchant plants								110,390				33,056	143,446
Utah: Furnace plants									285,430				285,430
Washington: Merchant plants											22,460		22,460
West Virginia:													
Merchant plants							32,243					734,706	766,949
Furnace plants				12,169			1,709,192					112,769	1,834,130
Total West Virginia				12,169			1,741,435					847,475	2,601,079
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin: Merchant plants				496,855			27,021			907		2,051,803	2,576,586
Undistributed: Merchant plants										316,448			316,448
Grand total	5,802,069	713,575	103,663	7,556,986	9,290	503	30,241,969	110,390	285,430	938,408	22,460	24,393,234	70,177,977
Merchant plants	1,337,927		103,663	1,398,971			2,445,381	110,390		598,751	22,460	12,461,842	18,479,385
Furnace plants	4,464,142	713,575		6,158,015	9,290	503	27,796,588		285,430	339,657		11,931,392	51,698,592

[1] Figures for 1938 not yet available. [2] Included under "Undistributed." [3] 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, by States, 1934–37* [1]

State	1934		1935		1936		1937	
	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive	Byproduct	Beehive
Alabama	69.73		68.91		69.66		72.37	
Colorado	66.21	65.17	68.22	64.91	66.68	65.25	67.36	55.71
Illinois	67.46		67.30		68.62		70.54	
Indiana	71.42		71.97		73.54		72.04	
Maryland	71.30		72.43		72.28		72.62	
Massachusetts	71.21		70.31		70.74		69.99	
Michigan	70.56		70.56		71.91		71.05	
Minnesota	68.46		68.29		69.22		70.27	
New Jersey	70.29		71.35		71.08		70.78	
New York	69.76		70.08		71.85		71.75	
Ohio	70.42		70.83		71.25		71.61	
Pennsylvania	67.78	64.08	67.84	63.99	68.39	64.56	68.83	65.50
Tennessee	69.91	47.94	69.31	51.25	68.95	51.80	69.00	53.89
Utah	60.47	52.49	59.78	47.21	56.88	57.59	56.67	54.25
Virginia		59.39		58.63		57.96		58.33
Washington	54.37	63.07	60.78	62.22	60.38	62.28	56.11	
West Virginia	67.79	61.00	69.89	60.85	70.19	61.06	70.67	61.74
United States average	69.44	62.90	69.78	62.44	70.47	63.23	70.73	64.23

[1] Figures for 1938 not yet available.

COKE BREEZE

Table 25.—*Coke breeze recovered at coke plants in 1937, by States* [1]

State	Yield per ton of coal (percent)	Produced		Used by producer: For steam raising		Used by producer: For other purposes, including water gas		Sold		Wasted (net tons)	On hand Dec. 31 (net tons)
		Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value		
Byproduct ovens:											
Alabama	4.86	286,194	$432,599	124,597	$160,504	6,816	$10,748	162,035	$260,672	12,914	29,841
Colorado	5.42	39,182	(2)	25,887	(2)			13,295	(2)		
Illinois	6.13	260,789	569,139	153,663	374,867	44,877	81,099	79,443	165,120		43,048
Indiana	5.46	414,435	1,026,836	240,906	537,809	124,433	258,275	54,769	250,197		16,314
Maryland	6.55	136,619	(2)	81,981	(2)	23,041	(2)			9,847	28,085
Massachusetts	7.60	122,771	(2)	78,131	(2)	7,534	(2)	36,344	(2)		2,973
Michigan	5.19	166,736	703,696	85,632	340,189	6,547	37,735	31,017	84,533		10,041
Minnesota	5.98	59,952	183,017	30,571	83,003	6,094	18,414	21,471	74,794		16,264
New Jersey	6.19	88,739	(2)	74,522	(2)			8,259	(2)		11,937
New York	4.39	302,646	776,492	176,640	417,224	63,970	191,356	73,171	189,227		45,807
Ohio	5.01	471,174	968,485	371,222	769,309	66,385	131,341	48,065	91,522		30,337
Pennsylvania	6.15	1,224,772	1,799,239	1,085,166	1,560,850	66,442	93,536	81,360	154,046		29,447
Tennessee	3.58	4,641	6,962	5,496	8,244						1,373
Utah	6.92	18,272	(2)	5,252	(2)	4,418	(2)	9,459	(2)		109
Washington	13.88	3,625	10,549	4,247	12,382	309	895				48
West Virginia	3.90	100,413	136,877	89,419	122,995	5,295	8,682	89	165		3,270
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	7.10	182,738	578,347	121,201	349,183	24,938	119,690	38,368	118,300		8,473
Undistributed			762,370		486,537		60,722		146,561		
Total byproduct, 1937	5.58	3,883,698	7,954,608	2,754,533	5,223,096	451,099	1,012,493	657,145	1,535,137	22,761	277,367
At merchant plants	5.97	1,085,786	2,755,786	650,291	1,658,017	123,093	346,105	321,980	776,182		129,129
At furnace plants	5.45	2,797,912	5,198,822	2,104,242	3,565,079	328,006	666,388	335,165	758,955	22,761	148,238
Total byproduct, 1936	5.66	3,577,222	7,265,615	2,581,230	5,111,445	369,410	857,732	697,918	1,477,045	9,006	285,775
Change in 1937 percent	−1.4	+8.6	+9.5	+6.7	+2.2	+22.1	+18.0	−5.8	+3.9	+152.7	−2.9
Beehive ovens:											
Colorado and Utah	[3] 2.36	3,016	4,531			1,129	1,129	1,769	3,190		848
Pennsylvania	[3] 4.54	88,942	108,229	5,650	6,935	1,239	251	42,383	50,520	35,581	6,186
Virginia	[3] 2.64	6,365	19,727	136	579	25	109	6,204	19,039		20
West Virginia	[3] 3.86	2,734	573					2,734	573		112
Total beehive, 1937	[3] 4.21	101,057	133,060	5,786	7,514	2,393	1,489	53,090	73,322	[4] 35,581	7,166

[1] Figures for 1938 not yet available.
[2] Included under "Undistributed."
[3] Yield computed by dividing production of breeze at the few plants reporting by the quantity of coal charged at these plants.
[4] As reported; quantity produced but not used was undoubtedly greater. See Mineral Resources, 1922, pt. 2, pp. 726–727.

CONSUMPTION OF COKE

Allowing for imports and exports and for changes in producers' stocks the indicated consumption of coke in 1938 was 31,222,635 tons. Of this amount 16,995,777 tons (about 54 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—14,226,858 tons (46 percent)—was used in foundries, in smelting the nonferrous metals, in the manufacture of water gas, in miscellaneous other industrial uses, and for domestic heating.

The consumption of coke for purposes other than iron manufacture has increased notably in recent years. In 1913 the total used for nonfurnace purposes was only 18 percent; by 1930 it had risen to 30 percent and by 1938 to 46 percent.

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 gross ton of pig iron declined from an average of 3,637.2 pounds in 1913 to 2,865.1 in 1938.

TABLE 26.—*Coke consumed in manufacture of pig iron and for other purposes, 1913, 1918, and 1936–38, 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
1936	46,275,184	329,957	670,312	−1,097,318	47,032,147	31,255,648	66.5	15,776,499	33.5
1937	52,375,469	286,364	526,683	+863,221	51,271,929	33,571,349	65.5	17,700,580	34.5
1938 [4]	32,633,304	135,240	486,571	+1,059,338	31,222,635	16,995,777	54.4	14,226,858	45.6

[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. [4] Subject to revision.

TABLE 27.—*Pounds of coke and coking coal consumed per gross ton of pig iron made in the United States, 1913, 1918, and 1936–38*

Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys	Year	Pounds of coke per gross ton of pig iron and ferro-alloys [1]	Percent yield of coke from coal	Calculated pounds coking coal per gross ton of pig iron and ferro-alloys
1913	2,433.3	66.9	3,637.2	1937	2,050.3	70.3	2,916.5
1918	2,375.2	66.4	3,577.1	1938 [2]	2,017.1	70.4	2,865.1
1936	2,036.2	70.2	2,900.6				

[1] From Report of American Iron and Steel Institute; the consumption per ton of pig iron only, excluding the furnaces making ferro-alloys, was 2,433.3 in 1913, 2,375.2 in 1918, 2,006.2 in 1936, 2,023.5 in 1937, and 1,987.6 in 1938.
[2] Subject to revision.

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 in 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 results in the production of correspondingly large quantities of coke. Since 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.

In years of heavy blast-furnace activity (such as 1937) the coke plants owned by or having contracts with steel interests concentrate on the production of furnace coke, and less is available for domestic and industrial use. When the reverse is true, as in 1938, the surplus metallurgical coke is thrown on the open market, sometimes at a lower-than-cost price. Thus, in 1933 only 54 percent of the total amount sold or used at coke plants was for blast-furnace use, and 43 percent was for domestic and other industrial use. In 1937 furnace coke at byproduct plants constituted 77 percent of the total, and 19 percent went for domestic and other industrial purposes. At beehive plants in the same year 65 percent was furnace and 24 percent domestic and other industrial. For the year 1938 only 37 percent of beehive coke went to blast furnaces, while 44 percent was sold for general domestic and industrial purposes. Complete figures are not yet available for the byproduct coke industry in 1938. It is known, however, that about 7,100,000 tons of coke were sold for domestic purposes in that year, a decrease of only 9 percent over 1937 compared with a general decrease of 35 percent in the total production of byproduct coke.

Table 28.—*Byproduct coke produced and sold or used by producer in 1937, by States* [1]

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace [2]		Sold: Furnace [3]		Sold: Foundry		Sold: Domestic use		Sold: Industrial and other use (including water gas) [4]		Sold: Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
Alabama	4,259,771	$13,275,098	2,861,130	$8,105,027	606,174	$1,409,992	243,705	$1,668,296	242,538	$1,018,106	159,351	$585,930	1,251,768	$4,682,324
Colorado	486,945	(5)	454,035	(5)	----------	----------	9,778	(5)	1,992	(5)	19,597	(5)	31,367	(5)
Illinois	2,998,663	20,213,129	1,870,425	11,904,163	10,753	73,320	230,668	2,229,631	781,056	5,300,860	61,672	415,567	1,084,149	8,019,378
Indiana	5,467,061	32,655,355	4,859,558	28,143,022	(5)	(5)	227,726	2,088,487	330,581	2,049,818	(5)	(5)	602,702	4,478,920
Maryland	1,513,651	(5)	1,439,740	(5)	----------	----------	----------	----------	----------	----------	39,972	(5)	39,972	(5)
Massachusetts	1,130,620	(5)	156,779	(5)	19,723	(5)	53,252	(5)	865,660	(5)	39,549	(5)	978,184	(5)
Michigan	2,283,518	13,816,401	582,344	3,362,884	(5)	(5)	(5)	(5)	1,037,602	6,425,361	180,523	1,109,501	1,628,886	10,019,165
Minnesota	704,631	5,611,287	240,629	1,459,134	----------	----------	175	1,644	359,948	3,297,761	17,578	134,643	377,701	3,434,048
New Jersey	1,015,073	(5)	177,625	(5)	34,872	(5)	34,143	(5)	521,084	(5)	237,310	(5)	827,409	(5)
New York	4,946,964	29,853,516	1,638,041	8,951,715	1,585,028	8,735,397	(5)	(5)	1,367,705	9,567,800	(5)	(5)	3,243,258	20,448,983
Ohio	6,737,881	32,185,945	4,905,139	22,656,759	773,235	3,950,307	222,004	1,520,694	536,197	2,605,229	117,926	647,821	1,649,362	8,724,051
Pennsylvania	13,701,262	55,142,252	11,291,739	42,412,240	1,349,956	5,784,088	178,985	1,604,496	599,412	3,818,818	149,073	910,420	2,277,426	12,117,822
Tennessee	89,451	432,943	13,609	65,867	----------	----------	24,046	116,383	20,833	100,832	15,532	75,175	60,411	292,390
Utah	149,659	(5)	85,649	(5)	----------	----------	----------	----------	6,395	(5)	56,712	(5)	63,107	(5)
Washington	14,656	87,936	14,856	89,135	----------	----------	----------	----------	361	2,166	----------	----------	361	2,166
West Virginia	1,817,993	5,822,004	1,521,135	4,468,429	80,567	355,714	(5)	(5)	123,683	473,098	(5)	(5)	292,587	1,336,641
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	1,892,949	13,628,440	117,464	838,028	226,209	965,384	296,984	2,817,257	1,012,745	7,366,623	205,527	1,413,318	1,741,465	12,562,582
Undistributed	----------	24,631,446	----------	11,841,934	359,111	2,322,698	178,939	2,356,733	----------	8,970,768	295,968	4,408,264	----------	12,579,930
Grand total, 1937	49,210,748	247,355,752	[2] 32,229,897	[2] 144,298,337	[3] 5,045,628	[3] 23,596,900	1,700,405	14,403,621	7,807,792	50,997,240	[4] 1,596,290	[4] 9,700,639	16,150,115	98,698,400
At merchant plants	13,076,539	84,334,632	1,853,585	10,277,735	2,226,157	10,714,846	1,374,137	12,096,758	6,247,006	42,248,659	1,105,370	7,043,490	10,952,670	72,103,753
At furnace plants	36,134,209	163,021,120	30,376,312	134,020,602	2,819,471	12,882,054	326,268	2,306,863	1,560,786	8,748,581	490,920	2,657,149	5,197,445	26,594,647
Grand total, 1936	44,569,121	225,695,719	28,981,459	134,258,244	3,717,934	17,171,056	1,672,538	12,439,148	9,643,507	58,494,793	1,512,688	8,333,053	16,546,667	96,438,050
Change in 1937..percent..	+10.4	+9.6	+11.2	+7.5	+35.7	+37.4	+1.7	+15.8	−19.0	−12.8	+5.5	+16.4	−2.4	+2.3

[1] Figures for 1938 not yet available.
[2] Includes 1,281,965 tons valued at $6,733,272 used to make producer or water gas and 529,013 tons, $2,744,853 used for other purposes than in blast furnaces.
[3] Includes 2,691,390 tons valued at $12,209,263 sold to financially affiliated corporations for blast furnace use, 734,056 tons, $4,360,297 sold for other purposes; and 1,620,182 tons, $7,027,340 reported as merchant sales.
[4] Includes 470,394 tons valued at $3,145,958 sold for manufacture of water gas.
[5] Included under "Undistributed."

TABLE 29.—*Beehive coke produced and sold or used by producer, 1937–38, by States*

[Exclusive of screenings or breeze]

State	Produced		Used by producer in blast furnace [1]		Sold: Furnace [2]		Sold: Foundry		Sold: Domestic use		Sold: Industrial and other use (including water gas) [3]		Sold: Total	
	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value	Net tons	Value
1937														
Colorado	64,222	(4)	60,715	(4)	-----	-----	-----	-----	-----	-----	3,187	(4)	3,187	(4)
Pennsylvania	2,559,048	$10,699,200	202,788	$1,008,305	1,549,724	$6,273,459	176,084	$906,216	285,468	$1,112,923	299,174	$1,217,611	2,310,450	$9,510,209
Tennessee	14,982	86,134	305	1,007	5,732	31,471	8,341	50,121	-----	-----	-----	-----	14,073	81,592
Utah	6,657	(4)	-----	-----	-----	-----	-----	-----	-----	-----	6,195	(4)	6,195	(4)
Virginia	240,425	1,180,800	-----	-----	80,270	372,126	49,943	267,454	703	3,545	109,440	538,017	240,356	1,181,142
West Virginia	279,387	1,232,182	102	(4)	127,562	525,147	104,049	505,841	13,555	49,571	32,854	143,962	278,020	1,224,521
Undistributed	-----	449,835	-----	387,133	-----	-----	-----	-----	-----	-----	-----	58,233	-----	58,233
	3,164,721	13,648,151	[1]263,910	[1]1,396,445	[2]1,763,288	[2]7,202,203	338,417	1,729,632	299,726	1,166,039	[3]450,850	[3]1,957,823	2,852,281	12,055,697
1938														
Colorado	54,721	(4)	53,985	(4)	-----	-----	-----	-----	-----	-----	792	(4)	792	(4)
Pennsylvania	482,105	1,945,790	49,589	204,878	79,902	307,819	111,799	509,578	90,347	315,105	169,229	677,324	451,277	1,809,826
Tennessee	5,500	28,435	-----	-----	2,200	(4)	3,300	(4)	-----	-----	-----	-----	5,500	28,435
Utah	7,668	(4)	-----	-----	-----	-----	2,749	(4)	729	(4)	4,190	(4)	7,668	(4)
Virginia	133,905	645,630	-----	-----	41,351	181,816	25,661	134,072	284	(4)	66,690	328,669	133,986	645,903
West Virginia	153,513	675,969	65	(4)	88,049	(4)	21,128	129,937	1,946	7,920	43,177	174,538	154,300	679,588
Undistributed	-----	406,971	-----	354,280	-----	379,425	-----	35,443	-----	5,230	-----	30,615	-----	53,739
	837,412	3,702,795	[1]103,639	[1]559,158	[2]211,502	[2]869,060	164,637	809,030	93,306	328,255	[3]284,078	[3]1,211,146	753,523	3,217,491

[1] Includes coke used for other purposes than in blast furnaces as follows: 1937, 1,516 tons valued at $6,996; 1938, 786 tons, $3,346.

[2] Includes coke sold or used as follows: Financially affiliated corporations—1937, 405,661 tons valued at $1,661,596; 1938, 41,567 tons, $179,687; merchant sales—1937, 1,353,423 tons, $5,518,733; 1938, 169,777 tons, $688,504; for other purposes—1937, 4,204 tons, $21,874; 1938, 158 tons, $869.

[3] Includes coke sold for manufacture of water gas as follows: 1937, 92,039 tons valued at $369,969; 1938, 68,427 tons, $258,106.

[4] Included under "Undistributed."

STOCKS OF COKE AND COKING COAL

With the growth of the domestic coke trade the problem of storing coke at the producers' plants has become increasingly important, especially during the spring and summer.

On January 1, 1938, byproduct coke in stock amounted to 2,519,320 tons, of which 1,878,652 tons (75 percent,) were for domestic and general industrial use. By the end of the year total byproduct stocks had risen to 3,609,694 tons, an increase of 43 percent. Merchant plants, which supply the bulk of the domestic trade, increased their stock piles 57 percent during 1938, rising almost steadily from a low point of 786,710 tons on April 1, 1937 to a high of 2,438,396 tons on December 1, 1938. Furnace plants ordinarily carry relatively steady stocks, although during the same period they fluctuated between 467,322 and 1,460,435, ending at 1,306,719 tons. Beehive plants as a rule carry but few stocks on hand due in part to sporadic activity of the ovens during the year. At the close of 1938 there were 44,931 tons of coke in inventory, of which 29,367 tons were for domestic use.

TABLE 30.—*Stocks of furnace, foundry, and domestic coke and of breeze on January 1, 1938, by States, in net tons*

[Based on complete reports from all producers]

State	Furnace	Foundry	Domestic and other	Total coke	Breeze
Byproduct plants:					
Alabama	191,197	4,829	49,322	245,348	29,841
Colorado	1,288	177	3,828	5,293	----------
Illinois	17,591	63	129,271	146,925	43,048
Indiana	17,663	886	68,735	87,284	16,314
Maryland	46,038	----------	----------	46,038	28,085
Massachusetts	53	----------	259,320	259,373	2,973
Michigan	1,342	298	117,759	119,399	10,041
Minnesota	6,649	----------	134,058	140,707	16,264
New Jersey	----------	----------	163,864	163,864	11,937
New York	[1] 10,510	([1])	286,270	296,780	45,807
Ohio	160,468	12,856	146,683	320,007	30,337
Pennsylvania	130,671	5,878	272,285	408,834	29,447
Tennessee	12,504	76	8,401	20,981	1,373
Utah	843	----------	659	1,502	109
Washington	----------	----------	462	462	48
West Virginia	14,398	4,080	20,450	38,928	3,270
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	[1] 310	([1])	217,285	217,595	8,473
Total byproduct	[1] 611,525	[1] 29,143	1,878,652	2,519,320	277,367
At merchant plants	16,802	23,002	1,435,027	1,474,831	129,129
At furnace plants	594,038	6,826	443,625	1,044,489	148,238
Beehive plants:					
Colorado	----------	320	----------	320	----------
Pennsylvania	8,760	10,081	47,995	66,836	6,186
Tennessee	1,237	298	----------	1,535	----------
Utah	----------	----------	393	393	848
Virginia	2,688	578	----------	3,266	20
West Virginia	857	1,987	773	3,617	112
Total beehive	13,542	13,264	49,161	75,967	7,166

[1] A small amount of foundry coke included with furnace.

TABLE 31.—*Summary of total stocks of coke on hand at all byproduct and beehive plants on Jan. 1, 1929 and 1934–38, in net tons*

	1929	1934	1935	1936	1937	1938
Byproduct plants:						
Furnace	750, 318	919, 583	922, 108	697, 699	282, 144	610, 840
Foundry	24, 426	64, 552	51, 069	15, 504	8, 981	29, 828
Domestic and other	1, 018, 205	1, 835, 743	2, 584, 481	2, 070, 544	1, 408, 350	1, 878, 652
	1, 792, 949	2, 819, 878	3, 557, 658	2, 783, 747	1, 699, 475	2, 519, 320
Beehive plants:						
Furnace	38, 446	5, 156	3, 133	2, 211	5, 622	13, 542
Foundry	8, 020	10, 979	8, 373	11, 146	8, 508	13, 264
Domestic and other	8, 511	29, 187	29, 379	32, 280	18, 461	49, 161
	54, 977	45, 322	40, 885	45, 637	32, 591	75, 967
Total:						
Furnace	788, 764	924, 739	925, 241	699, 910	287, 766	624, 382
Foundry	32, 446	75, 531	59, 442	26, 650	17, 489	43, 092
Domestic and other	1, 026, 716	1, 864, 930	2, 613, 860	2, 102, 824	1, 426, 811	1, 927, 813
	1, 847, 926	2, 865, 200	3, 598, 543	2, 829, 384	1, 732, 066	2, 595, 287

TABLE 32.—*Total stocks of coke at all furnace and nonfurnace byproduct plants on first of each month, 1937–38*

[Includes furnace, foundry, and domestic, but not breeze]

Month	Furnace plants		Other plants		Total	
	1937	1938	1937	1938	1937	1938
January	495, 732	1, 044, 489	1, 203, 743	1, 474, 831	1, 699, 475	2, 519, 320
February	464, 432	1, 086, 980	1, 068, 721	1, 279, 690	1, 533, 153	2, 366, 670
March	446, 085	1, 195, 691	861, 345	1, 278, 773	1, 307, 430	2, 474, 464
April	467, 322	1, 305, 298	786, 710	1, 471, 772	1, 254, 032	2, 777, 070
May	570, 001	1, 347, 919	902, 669	1, 785, 929	1, 472, 670	3, 133, 848
June	705, 835	1, 375, 558	1, 035, 360	1, 899, 317	1, 741, 195	3, 274, 875
July	776, 159	1, 411, 437	1, 067, 119	1, 963, 565	1, 843, 278	3, 375, 002
August	816, 708	1, 460, 435	1, 191, 844	2, 103, 738	2, 008, 552	3, 564, 173
September	859, 331	1, 453, 007	1, 376, 668	2, 255, 990	2, 235, 999	3, 708, 997
October	889, 399	1, 391, 947	1, 408, 905	2, 282, 596	2, 298, 304	3, 674, 543
November	914, 788	1, 333, 895	1, 430, 957	2, 382, 003	2, 345, 745	3, 715, 898
December	985, 115	1, 306, 719	1, 521, 982	2, 438, 396	2, 507, 097	3, 745, 115

For the first time in this chapter the Bureau of Mines presents statistics showing stocks of bituminous coal for coking at byproduct coke plants.

Stocks of bituminous coal follow closely the fluctuations in the trend of monthly coke production. In 1938 a low point was reached in May, when 4,867,332 tons were on hand; the peak occurred in December, with 7,462,163 tons in stock. The low month in coke production was June and the high month December.

TABLE 33.—*Stocks of bituminous coal at byproduct coke plants at end of each month, 1935–38*

Month	1935	1936	1937	1938
January	5, 014, 012	4, 640, 021	8, 030, 871	6, 469, 457
February	4, 989, 425	3, 844, 535	8, 687, 389	5, 822, 943
March	5, 680, 265	3, 431, 228	9, 638, 317	5, 231, 300
April	5, 656, 543	3, 514, 922	8, 543, 774	4, 934, 840
May	5, 591, 973	4, 064, 263	8, 187, 883	4, 867, 332
June	6, 446, 490	4, 565, 229	7, 770, 256	4, 999, 856
July	6, 607, 785	5, 302, 189	7, 432, 741	5, 364, 442
August	6, 950, 316	5, 982, 093	7, 455, 932	5, 539, 623
September	6, 803, 118	6, 562, 018	7, 760, 533	5, 951, 617
October	5, 985, 653	7, 295, 700	8, 066, 938	6, 459, 196
November	6, 129, 375	8, 146, 434	8, 114, 094	7, 172, 900
December	5, 559, 421	8, 535, 318	7, 273, 403	7, 462, 163

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 1938, prices on byproduct foundry coke advanced in five markets, decreased in five other markets, and remained stationary at Buffalo, N. Y. The increases ranged from 12 cents per ton in New England to 24 cents at Philadelphia, and decreases ranged from 2 cents at Indianapolis to 24 cents at Detroit. Connellsville prices, which have until recent years been regarded as basic reference prices for the entire industry, declined 6 cents for foundry coke and 43 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. No data are available at this time to show the actual receipts from coke sales at byproduct plants during 1938. Beehive coke operators have, however, reported the following average values obtained for their product: Furnace coke (merchant sales) $4.06, a decrease of 2 cents per ton from 1937; foundry coke $4.91, a decrease of 20 cents; for manufacture of water gas $3.77, a decrease of 25 cents; for other industrial use $4.42, a decrease of 1 cent; and for domestic use $3.52, a decrease of 37 cents. Total value of the 873,412 tons produced, including all coke used or sold for blast-furnace purposes, was $3,702,795, an average value of $4.42 per ton. At the same time the cost of the coal consumed in beehive ovens rose to $2.05 in 1938, an increase of 4 cents per ton from 1937.

TABLE 34.—*Average receipts per net ton for coke sold in 1937, by States* [1]

State	Byproduct				Beehive			
	Furnace [2]	Foundry	Domestic	Other industrial, including water gas	Furnace [2]	Foundry	Domestic	Other industrial, including water gas
Alabama	$2.33	$6.85	$4.20	$3.68				
Colorado and Utah		7.21	5.17	8.05				$6.21
Connecticut, Massachusetts, and Rhode Island		7.75	6.68	7.29				
Illinois	5.00	9.67	6.79	6.74				
Indiana		9.17	6.20	(3)				
Kentucky, Michigan, Missouri, and Wisconsin	4.90	9.48	6.47	6.30				
Maryland and New Jersey		(3)	6.88	6.15				
Minnesota		9.39	9.16	7.66				
New York	5.28	(3)	7.00	(3)				
Ohio	5.18	6.85	4.86	5.49				
Pennsylvania	4.20	8.96	6.37	6.11	$4.04	$5.15	$3.90	4.07
Tennessee		4.84	4.84	4.84	5.49	6.01		
Virginia					4.64	5.36	5.04	4.92
Washington			6.00					
West Virginia	4.33	(3)	3.83	3.95	4.12	4.86	3.66	4.38
Undistributed		9.15		6.64				
Average	4.46	8.47	6.53	6.08	4.08	5.11	3.89	4.34
At merchant plants	4.28	8.80	6.76	6.37	(4)	(4)	(4)	(4)
At furnace plants	4.56	7.07	5.61	5.41	(4)	(4)	(4)	(4)

1 Figures for 1938 not yet available.
2 Includes coke sold to affiliated corporations and merchant sales.
3 Included under "Undistributed."
4 Not available.

TABLE 35.—*Average monthly prices pet net ton at ovens of spot or prompt Connellsville furnace and foundry coke, 1929 and 1935–38* [1]

Month	Furnace coke					Foundry coke				
	1929	1935	1936	1937	1938	1929	1935	1936	1937	1938
January	$2.75	$3.85	$3.65	$4.00	$4.00	$3.75	$4.60	$4.25	$4.50	$5.00
February	2.90	3.85	3.65	4.06	4.00	3.75	4.60	4.25	4.50	5.00
March	2.98	3.85	3.65	4.25	4.00	3.75	4.60	4.25	4.50	5.00
April	2.78	3.85	3.65	4.51	4.00	3.75	4.60	4.25	5.00	5.00
May	2.75	3.85	3.65	4.60	4.00	3.75	4.60	4.25	5.25	5.00
June	2.75	3.59	3.65	4.58	3.85	3.75	4.15	4.25	5.25	4.85
July	2.75	3.27	3.50	4.35	3.75	3.75	3.88	4.00	5.00	4.75
August	2.73	3.29	3.61	4.35	3.75	3.75	4.00	4.00	5.00	4.75
September	2.65	3.25	3.69	4.27	3.75	3.75	4.00	4.05	5.00	4.75
October	2.65	3.53	3.75	4.25	3.75	3.75	4.20	4.25	5.00	4.75
November	2.65	3.60	3.75	4.25	3.75	3.75	4.25	4.25	5.00	4.75
December	2.64	3.57	3.92	4.00	3.75	3.75	4.15	4.40	5.00	4.75
Average	2.75	3.61	3.68	4.29	3.86	3.75	4.30	4.20	4.92	4.86

[1] Iron Age.

TABLE 36.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1934–38, as quoted by Steel*

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Birmingham, Ala. (at ovens):													
1934	$5.00	$5.00	$5.00	$5.40	$5.50	$5.70	$6.00	$6.00	$6.00	$6.00	$6.00	$6.00	$5.63
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
Buffalo, N. Y. (delivered at consumers' works): [1]													
1934	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
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
Chicago, Ill. (at ovens):													
1934	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
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
Cincinnati, Ohio (delivered at consumers' works):													
1934	(2)	(2)	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30	9.30
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
Cleveland, Ohio (delivered at consumers' works):													
1934	(2)	(2)	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
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
Detroit, Mich. (delivered at consumers' works): [1]													
1934	8.00	8.00	8.15	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.39
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
Indianapolis, Ind. (delivered at consumers' works):													
1934	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75	8.75
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

[1] Up to Oct. 26, 1936, quotations are "at ovens."
[2] Not quoted until March.

TABLE 36.—*Average monthly prices per net ton of byproduct foundry coke, in 11 markets, 1934–38, as quoted by Steel*—Continued

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
Newark, N. J. (delivered at consumers' works):													
1934	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71	8.71
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
New England (delivered at consumers' works):													
1934	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.87	11.00	10.57
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
Philadelphia, Pa. (delivered at consumers' works):													
1934	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
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
St. Louis, Mo. (delivered at consumers' works):													
1934	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
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

SHIPMENTS BY RAIL

TABLE 37.—*Beehive coke loaded for shipment on originating railroads in the United States, 1937–38, by routes, as reported by coke producers*

Route	State	Net tons: By States	Net tons: Total	Percent of total
1937				
Railroads:				
Baltimore & Ohio	Pennsylvania	419,224	459,825	15.1
	West Virginia	40,601		
Chesapeake & Ohio	do	40,335	40,335	1.3
Denver & Rio Grande Western	Colorado	63,902	71,866	2.4
	Utah	7,964		
Interstate	Virginia	211,249	211,249	6.9
Ligonier Valley	Pennsylvania	47,312	47,312	1.5
Louisville & Nashville	Virginia	3,120	3,120	.1
Monongahela	Pennsylvania	891,154	891,154	29.3
Nashville, Chattanooga & St. Louis	Tennessee	14,073	14,073	.5
New York Central	West Virginia	196,837	196,837	6.5
Norfolk & Western	Virginia	32,190	32,190	1.1
Pennsylvania	Pennsylvania	1,076,835	1,076,835	35.3
Pittsburgh & Lake Erie	do	1,000	1,000	(1)
Total railroad shipments		3,045,796	3,045,796	100.0
1938				
Railroads:				
Baltimore & Ohio	Pennsylvania	72,913	76,964	8.7
	West Virginia	4,051		
Chesapeake & Ohio	do	24,034	24,034	2.7
Denver & Rio Grande Western	Colorado	54,777	66,765	7.5
	Utah	11,988		
Interstate	Virginia	119,056	119,056	13.4
Ligonier Valley	Pennsylvania	7,864	7,864	.9
Louisville & Nashville	Virginia	500	500	.1
Monongahela	Pennsylvania	188,678	188,678	21.3
Nashville, Chattanooga & St. Louis	Tennessee	5,500	5,500	.6
New York Central	West Virginia	126,215	126,215	14.2
Norfolk & Western	Virginia	20,243	20,243	2.3
Pennsylvania	Pennsylvania	250,027	250,027	28.2
Pittsburgh & Lake Erie	do	1,381	1,381	.1
Total railroad shipments		887,227	887,227	100.0

1 Less than 0.1 percent.

EXPORTS AND IMPORTS [3]

Exports of coke from the United States totaled 486,571 tons valued at $3,035,105 in 1938, a decrease of 40,112 tons from the 1937 total of 526,683 tons. It is worthy of note that while United States production declined 38 percent, exports to foreign countries dropped less than 8 percent. As usual, the principal export movement was to Canada, which received 461,310 tons (95 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 6,013 tons were shipped to France and 5,880 tons to Switzerland in 1938.

Imports of coke supply an insignificant part of the requirements of the country and are a factor in the home market only in restricted localities. In 1938, 135,240 tons were received in the United States, supplied by only four countries—Canada, Belgium, Germany, and the United Kingdom—in order of importance.

TABLE 38.—*Coke [1] exported from the United States, 1936–38, by customs districts*

District	1936		1937		1938	
	Net tons	Value	Net tons	Value	Net tons	Value
Buffalo	302,006	$1,906,366	220,448	$1,406,897	222,484	$1,431,715
Chicago	33,463	171,006	11,535	84,472	22,813	100,381
Dakota	11,794	86,297	10,120	77,714	7,254	57,958
Duluth-Superior	3,711	27,879	3,697	32,144	3,214	27,745
Florida	3,472	21,058	3,750	76,125	4	53
Galveston	31	341			2,199	10,995
Maine and New Hampshire	436	3,432	859	7,297	94	831
Maryland	968	5,481	3,829	20,989	1,992	13,025
Michigan	246,103	1,508,978	221,763	1,459,913	169,292	975,592
Mobile	1,716	7,721	13,847	100,470	7,127	109,810
New Orleans	4,257	49,773	3,092	35,152	2,461	21,244
New York	1,030	11,756	4,623	70,082	12,517	89,905
Ohio	31,787	185,176	12,051	72,877	20,974	110,857
Philadelphia	7,251	68,517	12,597	80,358	11,255	51,770
Rochester			1,107	6,364	40	394
St. Lawrence	5,516	41,601	2,257	25,200	1,440	16,590
San Diego	540	6,067	129	2,005	252	4,176
Virginia	237	1,849	364	3,651	567	5,266
Wisconsin	15,027	80,271				
Other [2]	967	7,566	615	6,118	592	6,798
	670,312	4,191,135	526,683	3,567,828	486,571	3,035,105

[1] Includes coal and coke briquets prior to 1937.
[2] Includes values under $5,000.

[3] 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.

TABLE 39.—*Coke [1] exported from the United States, 1936–38, by countries*

Country	1936 Net tons	1936 Value	1937 Net tons	1937 Value	1938 Net tons	1938 Value
North America:						
Canada	650,036	$4,013,243	488,880	$3,185,966	461,310	$2,760,529
Central America: Panama	519	7,069	153	3,693	100	1,162
Mexico	1,365	12,555	488	4,706	790	10,287
West Indies:						
Cuba	2,257	10,597	14,854	81,347	2,168	17,299
Trinidad and Tobago	2	23	3,198	27,483	213	2,223
Other	418	6,246	390	6,568	353	4,729
South America:						
Bolivia	802	5,966			445	6,638
Chile	918	5,896	3,818	20,833	1,750	9,679
Other	46	699	115	4,238	494	5,672
Europe:						
France	4,359	36,546	605	7,441	6,013	53,108
Germany					1,417	10,628
Italy	3,125	42,933	9,156	156,196	2,760	40,861
Netherlands	487	4,282	1,247	10,006		
Norway	2,253	20,745	564	10,080	2,199	10,995
Switzerland			2,800	42,090	5,880	90,703
United Kingdom	3,639	23,402	336	5,866	679	10,592
Asia	17	300	79	1,315		
Africa: Liberia	1	25				
Oceania	68	608				
	670,312	4,191,135	526,683	3,567,828	486,571	3,035,105

[1] Includes coal and coke briquets prior to 1937.

TABLE 40.—*Coke imported for consumption in the United States, 1936–38, by customs districts*

District	1936 Net tons	1936 Value	1937 Net tons	1937 Value	1938 Net tons	1938 Value
Buffalo	30,523	$463,694	42,827	$650,182	24,527	$496,159
Dakota	2	26	(1)	5		
Hawaii	317	2,295	556	7,528	726	6,436
Los Angeles	38,100	133,945	40,826	183,274	23,752	130,187
Maine and New Hampshire	233	1,654	390	1,506	252	1,866
Massachusetts	74,165	286,291	37,738	169,021	19,852	76,212
Michigan	1,027	15,811	27	207		
Montana and Idaho	18,911	97,800	28,833	157,051	28,902	162,154
New York	120,225	464,796	76,489	315,443	6,983	32,683
Oregon	2,683	10,537	3,340	11,528	2,259	14,085
Rhode Island	8,360	34,722	4,749	28,808	1,120	6,005
St. Lawrence	697	4,516	1,628	10,424	61	446
San Antonio	517	2,309				
San Francisco	24,011	78,578	30,701	144,037	19,983	125,245
Vermont	143	1,018	360	2,690	260	1,910
Washington	10,045	37,509	17,900	97,798	6,563	40,758
	329,959	1,635,501	286,364	1,779,502	135,240	1,094,146

[1] Less than 1 ton.

TABLE 41.—*Coke imported for consumption in the United States, 1936–38, by countries*

Country	1936 Net tons	1936 Value	1937 Net tons	1937 Value	1938 Net tons	1938 Value
Belgium	158,920	$606,181	91,698	$401,516	35,772	$165,724
Canada	52,730	590,702	83,033	882,061	58,065	691,611
Germany	31,750	78,554	57,322	239,457	21,907	108,327
Mexico	516	2,309				
Netherlands	27,795	115,194	20,517	90,063		
Poland and Danzig	3,818	13,837				
United Kingdom	54,430	228,724	33,794	166,405	19,496	128,484
	329,959	1,635,501	286,364	1,779,502	135,240	1,094,146

WORLD PRODUCTION

Although data on world production of coke in 1938 are incomplete, figures are available to show the output of most of the principal producing countries. For the first time since 1921 the United States relinquished its position as the leading coke producer of the world. Germany led in 1938 with an output of 43,510,956 metric tons, followed by the United States, U. S. S. R., and Great Britain in the order named. World production of coke gained 22 percent in the decade 1928–37, most of the expansion occurring in U. S. S. R., which increased its production nearly fourfold during this period.

TABLE 42.—*Coke produced in principal countries, 1929 and 1935–38, in metric tons* [1]

[Compiled by M. T. Latus]

Country	1929	1935	1936	1937	1938
Australia:					
New South Wales	471,813	871,644	907,537	955,030	(2)
Queensland	4,144	25,276	23,701	30,949	31,474
Belgium	6,192,960	4,915,860	5,252,360	6,083,910	4,703,120
Bulgaria		1,705	1,683	4,550	3,923
Canada	1,986,532	1,663,515	1,830,101	1,984,581	1,810,358
China (exports)	13,467	7,246	11,422	9,062	11,630
Chosen	(3)	201,840	(3)	(3)	(2)
Czechoslovakia	3,170,629	1,553,869	1,955,515	3,279,864	(2)
France	9,080,127	7,083,170	7,101,380	7,900,000	(2)
Germany	39,421,033	29,801,234	35,832,617	40,896,343	43,510,956
Saar	2,423,000	(4)	(4)	(4)	(4)
Great Britain [5]	13,637,421	12,131,081	13,972,181	15,171,482	13,031,349
Hungary	2,092	22,981	24,133	35,092	(2)
India, British [6]	843,504	1,795,178	1,840,362	1,896,816	(2)
Indochina	637	260	109	128	3,503
Italy	791,607	998,379	1,210,714	1,693,024	(2)
Japan:					
Manufactured coke	(3)	1,833,492	(3)	(3)	(2)
Natural coke	(3)	396,214	(3)	(3)	(2)
Mexico	493,777	489,047	(3)	(3)	(2)
Netherlands	2,402,566	2,878,191	3,053,451	3,364,885	2,395,422
New Caledonia					43,317
Peru	35,899	(3)	(3)	3,607	(2)
Poland	1,858,052	1,386,716	1,615,598	2,125,519	2,523,290
Rhodesia, Southern	100,001	39,239	20,115	56,029	(2)
Rumania		45,920	63,214	77,828	(2)
Spain	768,040	(3)	(3)	(3)	(2)
Straits Settlements	15,667	9,324	9,619	10,134	10,400
Sweden	103,778	115,430	112,497	121,630	105,700
Turkey		33,653	37,411	74,792	(2)
Union of South Africa	99,297	64,782	75,459	109,133	163,315
U. S. S. R.	4,700,000	16,730,000	19,883,000	20,000,000	20,700,000
United States	54,325,427	31,879,449	41,979,921	47,513,978	29,604,281
	144,481,000	117,505,000	140,344,000	156,998,000	(2)

[1] Gas-house coke is not included.
[2] Data not available.
[3] Estimate included in total.
[4] Beginning with March 1935 production of the Saar is included with that of Germany.
[5] In Great Britain the production of gas-house coke (including breeze), not included above, is especially important and was as follows: 1935, 12,175,443 tons; 1936, 12,935,933 tons; 1937, 13,150,928 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: 1935, 904,840 tons; 1936, 932,534 tons; 1937, 850,581 tons.

COKE-OVEN BYPRODUCTS

The statistics in the following tables are confined to the major products obtained in high-temperature byproduct ovens. These products fall into five general groups, some of which are further subdivided. 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 1937 amounted to $2,944,439, 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 88,588,133 gallons, reported from eight plants. Total sales value of all byproducts in 1937 was $132,124,838, more than half the value of the coke production. If to this amount is added a value for the tar used by the producer ($10,490,075), and the value of the breeze production ($7,954,608), the ratio of the value of byproducts to the value of coke produced becomes about 3 to 5.

Complete statistics are not available at this time covering production and sales of byproducts during 1938; however, monthly reports received currently from coke operators throughout 1938 indicate a production of 873,405,000 pounds of ammonium sulfate and 44,025,000 pounds of ammonia liquor (NH_3 content), decreases of 32 and 19 percent, respectively, from 1937. The bulk of the ammonium sulfate is recovered at furnace plants, where coke production decreased 43 percent, while ammonia liquor is produced mainly at merchant plants, where the coke output dropped 15 percent. Benzol output (crude and refined plus motor benzol), as reported currently during 1938, amounted to 71,362,000 gallons, a loss of 39 percent from the 1937 total of 117,187,217 gallons. According to trade-journal reports the 1938 average price asked for sulfate of ammonia was $1.43 for 100 pounds, f. o. b. oven or port, an increase of 3 cents compared with the $1.40 price asked in 1937. Prices for benzol, from the same source, remained constant at $0.16 per gallon in tank lots.

TABLE 43.—*Byproducts obtained from coke-oven operations in the United States in 1937* [1]

[Exclusive of screenings or breeze]

Product	Production	Sales		
		Quantity	Value	
			Total	Average
Tar gallons	603,053,288	386,648,478	$18,456,483	$0.048
Ammonia:				
Sulfate pounds	1,289,740,739	1,332,308,748	14,477,234	.011
Ammonia liquor (NH_3 content) do	54,172,628	52,394,717	1,571,091	.030
Sulfate equivalent of all forms do			16,048,325	
	1,506,431,251	1,541,887,616		
Gas:				
Used under boilers, etc. M cubic feet	[2] 757,628,942	32,776,758	1,969,693	.060
Used in steel or affiliated plants do		251,571,649	25,419,223	.101
Distributed through city mains do		150,936,668	42,657,825	.283
Sold for industrial use do		27,757,884	2,914,956	.105
		463,042,959	72,961,697	.158
Light oil and derivatives:				
Crude light oil gallons	[3] 187,054,346	11,113,150	955,459	.086
Benzol, crude and refined do	21,660,522	22,140,936	2,928,471	.132
Motor benzol do	95,526,695	93,767,208	8,384,863	.089
Toluol, crude and refined do	20,896,724	20,173,723	5,350,087	.265
Solvent naphtha do	5,725,918	5,255,014	988,411	.188
Xylol do	4,562,344	4,245,316	1,176,723	.277
Other light-oil products do	8,130,103	5,522,858	431,390	.078
	[4] 156,502,306	162,218,205	20,215,404	.125
Naphthalene, crude and refined pounds	60,797,108	60,315,581	1,182,992	.020
Tar derivatives:				
Creosote oil, distillate as such gallons	15,401,597	14,900,402	1,452,879	.098
Creosote oil in coal-tar solution do	1,908,550	1,048,044	89,223	.085
Pitch of tar net tons	236,312	4,314	36,848	8.541
Other tar derivatives			1,310,612	
Phenol gallons	104,738	110,181	43,272	.393
Sodium phenolate do	154,112	147,545	11,605	.079
Other products [5]			315,498	
Value of all byproducts sold			[6] 132,124,838	

[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.; figures for 1938 not yet available.
[2] Includes gas wasted and gas used for heating retorts.
[3] Refined on the premises to make the derived products shown, 182,030,795 gallons.
[4] Total gallons of derived products.
[5] Ammonia thiocyanate, asphalt paint, carbolates, crude ferrocyanide, cyanogen sludge, extide covering, insecticides, light carbolic oils, pyridine oil, sodium carbolate, sodium prussiate, spent soda solution, sulfur (brimstone), and vented vapors.
[6] Exclusive of the value of breeze production, which amounted to $7,954,608.

TABLE 44.—*Coal equivalent of byproducts of byproduct coking, 1913, 1914, 1918, and 1936–37* [1]

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
1936	3, 577	434	560, 386	170, 234	71, 540	238, 700	84, 058	22, 130	416, 428	15, 894, 000	24. 1
1937	3, 884	463	603, 053	187, 054	77, 680	254, 650	90, 458	24, 317	447, 105	17, 065, 000	22. 9

[1] Figures for 1938 not yet available.

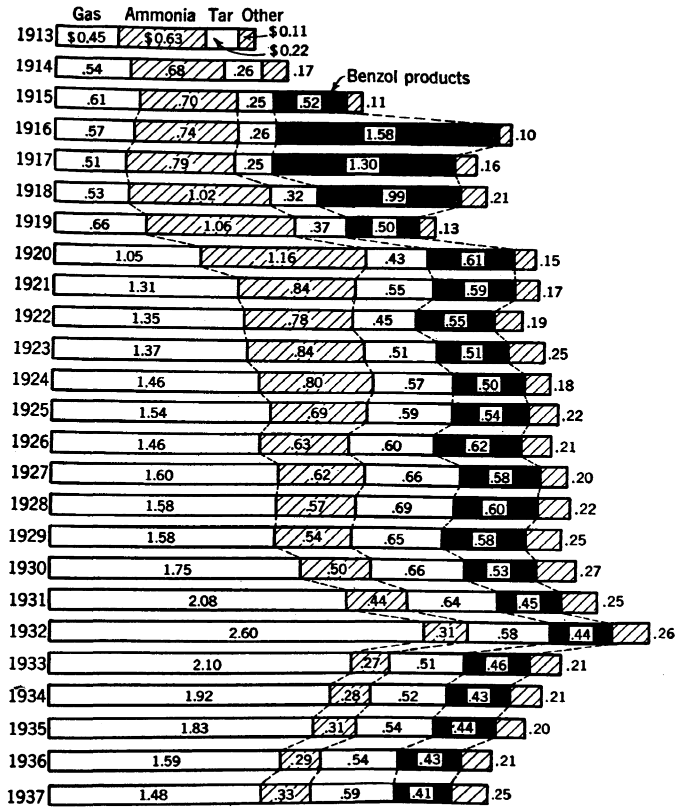

FIGURE 3.—Gross value of the several byproducts per ton of byproduct coke produced, 1913–37.

COKE-OVEN GAS

TABLE 45.—*Coke-oven gas produced and sold in the United States in 1937, by States* [1]

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	
Alabama	7	65,441,380	28,532,219	33,232,889	$2,393,212	$0.072	3,676,272
Colorado	1	8,615,186	4,055,442	4,463,932	(2)	(2)	95,812
Illinois	8	43,241,620	13,615,167	27,866,444	5,001,230	.179	1,760,009
Indiana	6	81,623,621	33,996,586	46,281,736	7,365,936	.159	1,345,299
Maryland	1	19,502,322	8,562,127	10,940,195	(2)	(2)	----------
Massachusetts	2	18,262,596	5,817,048	12,396,634	(2)	(2)	48,914
Michigan	8	37,576,334	13,401,137	24,152,942	3,293,338	.136	22,255
Minnesota	3	11,336,546	4,808,208	6,443,393	1,646,201	.255	84,945
New Jersey	2	16,727,254	3,746,432	12,980,822	(2)	(2)	----------
New York	8	74,109,497	18,772,989	53,716,629	15,590,334	.290	1,619,879
Ohio	14	98,205,869	42,120,697	54,135,781	5,994,264	.111	1,949,391
Pennsylvania	12	221,351,285	86,843,114	131,803,433	14,989,921	.114	2,704,738
Tennessee	1	1,222,221	549,990	672,231	167,636	.249	----------
Utah	1	3,506,484	1,607,415	1,645,645	(2)	(2)	253,424
Washington	1	294,893	----------	266,377	96,518	.362	28,516
West Virginia	4	27,869,082	8,917,819	18,935,138	1,614,587	.085	16,125
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	6	28,742,752	5,288,280	23,108,738	6,869,932	.297	345,734
Undistributed	--------	----------	----------	----------	7,938,588	.187	----------
Grand total, 1937	85	757,628,942	280,634,670	463,042,959	72,961,697	.158	13,951,313
At merchant plants	42	199,595,970	50,812,233	145,111,921	37,545,461	.259	3,671,816
At furnace plants	43	558,032,972	229,822,437	317,931,038	35,416,236	.111	10,279,497
Grand total, 1936	85	699,701,415	254,125,915	433,639,041	70,830,970	.163	11,936,459
Change in 1937 ... percent	--------	+8.3	+10.4	+6.8	+3.0	−3.1	+16.9

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1937, by States* [1]

State	Used by producer					
	Under boilers			In steel or other affiliated plants		
	M cubic feet	Value		M cubic feet	Value	
		Total	Average		Total	Average
Alabama	9,653,158	$484,338	$0.050	17,303,254	$1,164,838	$0.067
Colorado	----------	----------	----------	4,463,932	(2)	(2)
Illinois	2,790,802	243,768	.087	4,573,953	665,157	.145
Indiana	449,850	27,969	.062	37,344,041	4,901,093	.131
Maryland	----------	----------	----------	4,766,140	(2)	(2)
Massachusetts	192,679	(2)	(2)	----------	----------	----------
Michigan	1,724,282	86,214	.050	12,447,720	1,998,886	.161
Minnesota	412,629	23,535	.057	1,918,685	233,120	.121
New Jersey	805	(2)	(2)	----------	----------	----------
New York	2,552,498	153,650	.060	14,905,212	1,626,293	.109
Ohio	3,506,494	338,203	.096	39,731,888	3,791,352	.095
Pennsylvania	9,907,717	498,413	.050	97,326,768	8,694,530	.089
Tennessee	172,020	6,021	.035	----------	----------	----------
Utah	964,194	(2)	(2)	23,092	(2)	(2)
Washington	1,445	72	.050	----------	----------	----------
West Virginia	98,045	6,201	.063	16,766,964	1,273,868	.076
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	350,140	35,456	.101	----------	----------	----------
Undistributed	----------	65,853	.057	----------	1,070,086	.116
Grand total, 1937	32,776,758	1,969,693	.060	251,571,649	25,419,223	.101
At merchant plants	10,110,538	709,571	.070	5,517,065	435,626	.079
At furnace plants	22,666,220	1,260,122	.056	246,054,584	24,983,597	.102
Grand total, 1936	28,807,618	1,764,469	.061	226,229,045	21,717,052	.096
Change in 1937 ... percent	+13.8	+11.6	−1.6	+11.2	+17.0	+5.2

[1] Figures for 1938 not yet available. [2] Included under "Undistributed."

TABLE 46.—*Disposition of surplus coke-oven gas in the United States in 1937, 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
Alabama	3,878,947	$527,022	$0.136	2,397,530	$217,014	$0.091
Colorado						
Illinois	19,568,662	4,051,776	.207	933,027	40,529	.043
Indiana	7,309,260	2,209,537	.302	1,178,585	227,337	.193
Maryland	6,174,055	(2)	(2)			
Massachusetts	12,155,063	(2)	(2)	48,892	(2)	(2)
Michigan	3,916,893	749,693	.191	6,064,047	458,545	.076
Minnesota	4,112,079	1,389,546	.338			
New Jersey	12,980,017	(2)	(2)			
New York	34,792,173	13,493,835	.388	1,466,746	316,556	.216
Ohio	7,533,563	1,504,569	.200	3,363,836	360,140	.107
Pennsylvania	17,396,608	5,177,371	.298	7,172,340	619,607	.086
Tennessee	500,211	161,615	.323			
Utah	505,809	(2)	(2)	152,550	(2)	(2)
Washington	264,932	96,446	.364			
West Virginia				2,070,129	334,518	.162
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	19,848,396	6,517,221	.328	2,910,202	317,255	.109
Undistributed		6,779,194	.213		23,455	.116
Grand total, 1937	150,936,668	42,657,825	.283	27,757,884	2,914,956	.105
At merchant plants	111,786,375	34,426,693	.308	17,697,943	1,973,571	.112
At furnace plants	39,150,293	8,231,132	.210	10,059,941	941,385	.094
Grand total, 1936	156,063,794	44,711,670	.286	22,538,584	2,637,779	.117
Change in 1937 percent	−3.3	−4.6	−1.0	+23.2	+10.5	−10.3

[2] Included under "Undistributed."

TAR

TABLE 47.—*Coke-oven tar produced and sold in the United States in 1937, by States, in gallons* [1]

State	Produced [2]		Sold				
	Total	Per ton of coal coked	For use as fuel [3]	For refining into tar products	Total sold	Value	
						Total	Average
Alabama	49,708,921	8.44	13,203,979	19,628,010	32,831,989	$1,537,644	$0.047
Colorado	7,739,960	10.71		914,552	914,552	(4)	(4)
Illinois	33,000,822	7.76	5,056,259	26,281,660	31,337,919	1,507,873	.048
Indiana	50,963,172	6.72	6,178,595	17,693,794	23,872,389	1,157,287	.048
Maryland	15,944,609	7.65		16,664,611	16,664,611	(4)	(4)
Massachusetts	12,823,356	7.94	582,930	12,188,282	12,771,212	(4)	(4)
Michigan	25,798,473	8.03	11,227,519	14,532,308	25,759,827	1,301,725	.051
Minnesota	7,666,070	7.64		7,761,536	7,761,536	417,224	.054
New Jersey	11,098,776	7.74	3,247,485	7,621,704	10,869,189	(4)	(4)
New York	62,965,714	9.13	12,069,970	47,676,220	59,746,190	2,778,347	.047
Ohio	75,430,626	8.02	15,406,534	47,958,077	63,364,611	3,272,044	.052
Pennsylvania	200,816,522	10.09	29,157,340	25,637,892	54,795,232	2,119,076	.039
Tennessee	800,290	6.17		812,698	812,698	32,496	.040
Utah	3,041,764	11.52		3,084,116	3,084,116	(4)	(4)
Washington	136,447	5.22	170,543		170,543	4,264	.025
West Virginia	25,607,885	9.96		22,717,778	22,717,778	1,157,858	.051
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	19,509,881	7.58		19,174,086	19,174,086	943,124	.049
Undistributed						2,227,521	.050
Grand total, 1937	603,053,288	8.67	96,301,154	290,347,324	386,648,478	18,456,483	.048
At merchant plants	151,574,528	8.33	12,429,005	134,859,391	147,288,396	6,857,961	.047
At furnace plants	451,478,760	8.79	83,872,149	155,487,933	239,360,082	11,598,522	.048
Grand total, 1936	560,385,578	8.86	118,537,218	239,645,541	358,182,759	15,328,340	.043
Change in 1937 percent	+7.6	−2.1	−18.8	+21.2	+7.9	+20.4	+11.6

[1] Figures for 1938 not yet available. [2] Includes 88,588,133 gallons of tar "refined at plant."
[3] Comprises 18,434,195 gallons sold to affiliated corporations and 77,866,959 gallons sold to other purchasers.
[4] Included under "Undistributed."

TABLE 47.—*Coke-oven tar produced and sold in the United States in 1937, by States, in gallons*—Continued

State	Used by producer [5]			On hand Dec. 31
	As fuel under boilers	In open hearth or affiliated plants	Otherwise	
Alabama	671,889	13,648,017	261,959	4,512,639
Colorado		3,147,156	74,730	255,377
Illinois		117,822		2,860,710
Indiana		28,080,741	13,104	1,949,925
Maryland		17,476		1,164,915
Massachusetts				411,022
Michigan			8,650	2,339,541
Minnesota				367,543
New Jersey				888,077
New York		729,753	8,614	3,204,398
Ohio	489,180	9,601,831	193,161	2,041,485
Pennsylvania	968,229	63,064,255	1,461,804	10,581,700
Tennessee				19,958
Utah				104,975
Washington				
West Virginia		3,071,421		481,901
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin			1,558	936,808
Undistributed				
Grand total, 1937	2,129,298	121,478,472	2,023,580	32,120,974
At merchant plants			10,574	8,181,716
At furnace plants	2,129,298	121,478,472	2,013,006	23,939,258
Grand total, 1936	1,739,326	145,623,890	476,029	29,413,219
Change in 1937 ... percent	+22.4	−16.6	+325.1	+9.2

[5] Excludes 88,588,133 gallons of tar "refined at plant" that cannot be shown by States without disclosing individual operations.

AMMONIA

TABLE 48.—*Ammonia produced at coke-oven plants and sold in 1937, by States, in pounds* [1]

State	Active plants	Sulfate equivalent of all forms		Produced as—	
		Total	Per ton of coal coked	Sulfate	Liquor (NH_3 content)
Alabama	7	144,118,327	24.48	125,122,491	4,748,959
Colorado	1	16,955,200	23.46	16,955,200	
Illinois	7	87,201,369	21.03	64,608,729	5,648,160
Indiana	6	143,042,231	18.85	125,946,503	4,273,932
Maryland	1	43,949,685	21.08	43,949,685	
Massachusetts	2	37,725,092	23.35	34,976,300	687,198
Michigan	8	66,067,708	20.56	30,916,008	8,787,925
Minnesota	3	16,582,715	16.54	16,582,715	
New Jersey	2	28,224,885	19.68	28,224,885	
New York	8	150,853,252	21.88	121,982,080	7,217,793
Ohio	14	200,595,930	21.32	161,006,658	9,897,318
Pennsylvania	12	459,539,764	23.08	440,520,824	4,754,735
Tennessee	1	2,902,694	22.39	2,902,694	
Utah	1	7,081,508	26.82	7,081,508	
West Virginia	3	48,989,973	23.07	48,989,973	
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	5	52,600,918	20.68	19,974,486	8,156,608
Undistributed					
Grand total, 1937	81	1,506,431,251	21.84	1,289,740,739	54,172,628
At merchant plants	38	383,408,295	21.79	223,446,603	39,990,423
At furnace plants	43	1,123,022,956	21.86	1,066,294,136	14,182,205
Grand total, 1936	81	1,388,682,583	22.14	1,199,645,603	47,259,245
Change in 1937 ... percent		+8.5	−1.4	+7.5	+14.6

[1] Figures for 1938 not yet available.

TABLE 48.—*Ammonia produced at coke-oven plants and sold in 1937, by States, in pounds*—Continued

State	Sold as— Sulfate Pounds	Sulfate Value	Liquor (NH_3 content) Pounds	Liquor (NH_3 content) Value
Alabama	113, 653, 896	$1, 444, 208	4, 784, 357	$162, 191
Colorado	18, 122, 919	(2)		
Illinois	64, 060, 092	643, 549	5, 730, 533	(2)
Indiana	116, 869, 983	1, 240, 291	4, 169, 886	104, 331
Maryland	42, 177, 338	(2)		
Massachusetts	39, 356, 420	(2)	678, 941	(2)
Michigan	29, 651, 214	383, 227	8, 269, 123	228, 120
Minnesota	16, 273, 677	173, 639		
New Jersey	28, 648, 344	(2)		
New York	131, 875, 257	1, 479, 412	7, 254, 510	228, 053
Ohio	168, 387, 179	1, 780, 207	9, 365, 816	295, 474
Pennsylvania	479, 838, 829	4, 980, 271	4, 240, 291	143, 464
Tennessee	2, 013, 000	26, 572		
Utah	7, 769, 855	(2)		
West Virginia	54, 501, 171	587, 129		
Connecticut, Kentucky, Missouri, Rhode Island, and Wisconsin	19, 109, 574	229, 484	7, 901, 260	200, 278
Undistributed		1, 509, 245		209, 180
Grand total, 1937	1, 332, 308, 748	14, 477, 234	52, 394, 717	1, 571, 091
At merchant plants	230, 626, 834	2, 608, 117	39, 278, 125	1, 177, 106
At furnace plants	1, 101, 681, 914	11, 869, 117	13, 116, 592	393, 985
Grand total, 1936	1, 123, 343, 067	11, 484, 191	46, 907, 237	1, 328, 788
Change in 1937 percent	+18. 6	+26.1	+11. 7	+18. 2

[2] 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 in 1937, by States, in gallons* [1]

State	Active plants	Produced: Total	Produced: Per ton of coal coked	Refined on premises	Total derived products obtained from refining operations	Total derived products sold [2]	Value of derived products sold [2]
Alabama	7	16, 536, 053	2. 81	15, 262, 617	13, 424, 517	12, 875, 046	$1, 479, 368
Colorado	1	2, 325, 559	3. 22	2, 320, 022	1, 803, 373	1, 644, 311	(3)
Illinois	5	9, 925, 300	2. 56	5, 115, 126	4, 233, 636	4, 166, 055	495, 684
Indiana	4	18, 983, 999	2. 70	19, 547, 814	16, 722, 110	16, 874, 784	2, 152, 623
Maryland	1	6, 238, 540	2. 99	6, 217, 697	5, 370, 217	5, 526, 498	(3)
Michigan	3	7, 201, 206	2. 50	4, 875, 833	4, 414, 562	803, 441	(3)
New York	7	15, 761, 103	2. 56	26, 042, 804	22, 166, 551	22, 727, 293	3, 387, 363
Ohio	14	26, 480, 820	2. 81	25, 210, 713	20, 271, 494	20, 118, 453	2, 694, 724
Pennsylvania	10	61, 353, 947	3. 26	59, 657, 052	52, 684, 412	51, 454, 445	5, 992, 680
Tennessee	1	299, 718	2. 31	301, 893	221, 814	219, 054	27, 998
Utah	1	1, 058, 706	4. 01	1, 054, 733	810, 883	798, 328	(3)
West Virginia	4	8, 503, 995	3. 31	8, 543, 251	7, 359, 042	6, 975, 646	998, 765
Connecticut, Kentucky, Massachusetts, Minnesota, Missouri, New Jersey and Wisconsin	8	12, 385, 400	2. 20	7, 881, 240	7, 019, 695	6, 921, 701	1, 041, 642
Undistributed							989, 098
Grand total 1937	66	187, 054, 346	2. 86	182, 030, 795	156, 502, 306	151, 105, 055	19, 259, 945
At merchant plants	25	34, 488, 753	2. 35	30, 879, 561	26, 911, 840	27, 091, 829	4, 052, 719
At furnace plants	41	152, 565, 593	3. 01	151, 151, 234	129, 590, 466	124, 013, 226	15, 207, 226
Grand total, 1936	62	170, 234, 202	2. 91	163, 990, 960	140, 972, 234	136, 294, 329	17, 967, 013
Change in 1937 percent	+6. 5	+9. 9	−1. 7	+11. 0	+11. 0	+10. 9	+7. 2

[1] Figures for 1938 not yet available.
[2] Excludes 11,113,150 gallons valued at $955,459 of crude oil sold as such.
[3] Included under "Undistributed."

NAPHTHALENE

TABLE 50.—*Crude and refined naphthalene sold by byproduct-coke operators, 1933–37* [1]

Year	Pounds	Value: Total	Value: Average receipts per pound (cents)	Receipts per ton of coke (cents)
1933	6,523,204	$67,472	1.0	0.3
1934	10,500,285	131,299	1.3	.4
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

[1] Figures for 1938 not yet available.

BYPRODUCT COKE OVENS OWNED BY CITY-GAS COMPANIES (PUBLIC UTILITY PLANTS)

Adaptation of the byproduct coke oven 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 the 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 the 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 1938, with only 18 plants active, the coke product was 3,247,548 tons, a little more than 10 percent of national 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, 1936–37* [1]

Product	1936			1937		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [2]	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities) [2]	Total
Number of active plants	64	21	85	65	20	85
Coke:						
Production ..... net tons	40,954,836	3,614,285	44,569,121	45,699,231	3,511,517	49,210,748
Value	$202,419,225	$23,276,494	$225,695,719	$223,873,967	$23,481,785	$247,355,752
Average value	$4.94	$6.44	$5.06	$4.90	$6.69	$5.03
Screenings or breeze:						
Production ..... net tons	3,232,638	344,584	3,577,222	3,577,183	306,515	3,883,698
Sales ..... do	670,835	27,083	697,918	633,108	24,037	657,145
Value	$1,406,193	$70,852	$1,477,045	$1,473,253	$61,884	$1,535,137
Average value	$2.10	$2.62	$2.12	$2.33	$2.57	$2.34
Coal charged into ovens:						
Quantity ..... net tons	58,110,600	5,132,917	63,243,517	64,594,504	4,980,869	69,575,373
Coke:						
Used by producer:						
Quantity ..... net tons	[3] 27,987,459	994,000	[3] 28,981,459	31,500,121	729,776	32,229,897
Value	[3] $128,119,293	$6,138,951	[3] $134,258,244	$139,929,373	$4,368,964	$144,298,337
Sales:						
Quantity ..... net tons	13,762,584	2,784,083	16,546,667	13,407,427	2,742,688	16,150,115
Value	$78,348,913	$18,089,137	$96,438,050	$79,857,905	$18,840,495	$98,698,400
Byproducts:						
Gas:						
Production M cubic feet	640,547,854	59,153,561	699,701,415	699,623,138	58,005,804	757,628,942
Sales of surplus:						
Used under boilers:						
Quantity M cubic feet	28,705,273	102,345	28,807,618	32,750,748	26,010	32,776,758
Value	$1,754,280	$10,189	$1,764,469	$1,968,036	$1,657	$1,969,693
Used in steel or affiliated plants:						
Quantity M cubic feet	226,211,134	17,911	226,229,045	251,552,978	18,671	251,571,649
Value	$21,707,660	$9,392	$21,717,052	$25,413,963	$5,260	$25,419,223
Distributed through city mains:						
Quantity M cubic feet	104,592,472	51,471,322	156,063,794	99,374,929	51,561,739	150,936,668
Value	$26,656,284	$18,055,386	$44,711,670	$24,734,750	$17,923,075	$42,657,825
Sold for industrial use:						
Quantity M cubic feet	21,096,829	1,441,755	22,538,584	26,290,137	1,467,747	27,757,884
Value	$2,204,768	$433,011	$2,637,779	$2,515,049	$399,907	$2,914,956
Tar:						
Production ..... gallons	510,765,616	49,619,962	560,385,578	555,607,964	47,445,324	603,053,288
Sales:						
Quantity ..... do	309,380,205	48,802,554	358,182,759	341,254,792	45,393,686	386,648,478
Value	$13,236,605	$2,091,735	$15,328,340	$16,397,396	$2,059,087	$18,456,483
Average value	$0.043	$0.043	$0.043	$0.048	$0.045	$0.048
Ammonia:						
Production (NH_3 equivalent of all forms) pounds	320,861,321	26,309,324	347,170,645	350,803,763	25,804,050	376,607,813
Liquor (NH_3 content):						
Production ..... pounds	42,707,324	4,551,921	47,259,245	49,717,008	4,455,620	54,172,628
Sales ..... do	42,315,907	4,591,330	46,907,237	47,970,372	4,424,345	52,394,717
Value	$1,238,752	$90,036	$1,328,788	$1,482,593	$88,498	$1,571,091
Sulfate:						
Production ..... pounds	1,112,615,989	87,029,614	1,199,645,603	1,204,347,020	85,393,719	1,289,740,739
Sales ..... do	1,044,424,839	78,918,228	1,123,343,067	1,246,437,212	85,871,536	1,332,308,748
Value	$10,653,237	$830,954	$11,484,191	$13,533,822	$943,412	$14,477,234
Crude light oil:						
Production ..... gallons	166,275,705	3,958,497	170,234,202	183,223,825	3,830,521	187,054,346
Sales ..... do	7,483,501	2,879,675	10,363,176	8,322,515	2,790,635	11,113,150
Value	$722,799	$248,965	$971,764	$707,807	$247,652	$955,459

[1] Figures for 1938 not yet available.
[2] 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.
[3] Revised figures.

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, 1936–37*—Continued

Product	1936			1937		
	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total	Plants not owned by city gas companies	Plants owned by city gas companies (public utilities)	Total
Byproducts—Contd.						
Light oil derivatives:						
Production....gallons..	140,137,380	834,854	140,972,234	155,610,298	892,008	156,502,306
Sales.............do....	135,476,381	817,948	136,294,329	150,225,547	879,508	151,105,055
Value..................	$17,845,767	$121,246	$17,967,013	$19,128,211	$131,734	$19,259,945
Naphthalene, crude and refined:						
Production....pounds..	37,395,607	156,612	37,552,219	59,863,754	933,354	60,797,108
Sales.............do....	34,793,228	153,662	34,946,890	59,384,227	931,354	60,315,581
Value..................	$567,549	$2,746	$570,295	$1,167,536	$15,456	$1,182,992
All other products, value.	$1,655,909	$68,363	$1,724,272	$3,126,280	$133,657	$3,259,937

FUEL BRIQUETS AND PACKAGED FUEL [1]

By G. S. Goodman

SUMMARY OUTLINE

The domestic production of fuel briquets in 1938 totaled 871,260 net tons valued at $5,701,890. This represents a decrease in quantity of 12.5 percent from 1937 and 23 percent from 1936. The decline in 1938 was due principally to the mild winter, but it is believed that unsettled coal prices also may have been partly responsible.

Despite the curtailment in output, interest in fuel briquetting appears to be gaining, as evidenced by the 35 plants in operation in 1938 (8 of them new), the largest number since the beginning of the industry. Three other plants were under construction or being operated experimentally at the end of the year.

The production of packaged fuel in 1938 increased 10 percent, reaching a total of 160,952 tons valued at $1,405,253 compared with 146,037 tons valued at $1,287,320 in 1937. The gain, however, was not so marked as in 1937, when the production was more than double that of 1936. Operators reported that their output in 1938 would have been considerably greater if winter temperatures had been normal.

Reports received by the Bureau of Mines on fuel-briquetting and packaged-fuel operations for 1938 show that these two industries apparently are not competitive, as fuel briquets are designed to stand shipment for a considerable distance whereas packaged fuel is principally for local or nearby consumption. The average fuel-briquetting plant in 1938 produced about 25,000 tons a year and shipped by rail to far destinations, while the average packaged-fuel plant produced only about 3,000 tons, mostly for local consumption.

Statistics on fuel briquets and packaged fuel are presented separately in this report.

[1] Directories of fuel-briquetting and packaged-fuel plants operating in 1938 and names of manufacturers of equipment will be furnished on request by the Coal Economics Division, Bureau of Mines, Washington, D. C.

FUEL BRIQUETS

The salient statistics of the fuel-briquetting industry from 1934 to 1938 are summarized in the following table.

Salient statistics of the fuel-briquet industry in the United States, 1934–38

[Data regarding packaged fuel are given separately at end of this report]

Year	Production (thousands of net tons): Eastern States	Production: Central States	Production: Pacific Coast States	Production: Total	Imports (thousands of net tons)	Exports[1] (thousands of net tons)	Consumption[2] (thousands of net tons)	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	Average value per net ton: Central States	Average value per net ton: Pacific Coast States
1934	264	388	53	705	------	(1)	705	4,276	27	26	$4.72	$6.54	$9.33
1935	310	485	66	861	17	(1)	878	5,476	29	30	4.48	7.16	9.29
1936	351	702	72	1,125	20	(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

1 Exports not reported separately by Bureau of Foreign and Domestic Commerce prior to 1937.
2 Production plus imports minus exports.

Production.—Production of briquets in 1938 totaled 871,260 net tons, a decrease of 124,670 tons (12.5 percent) from 1937. (See fig. 1.) The greatest relative decrease was in the Pacific Coast States.

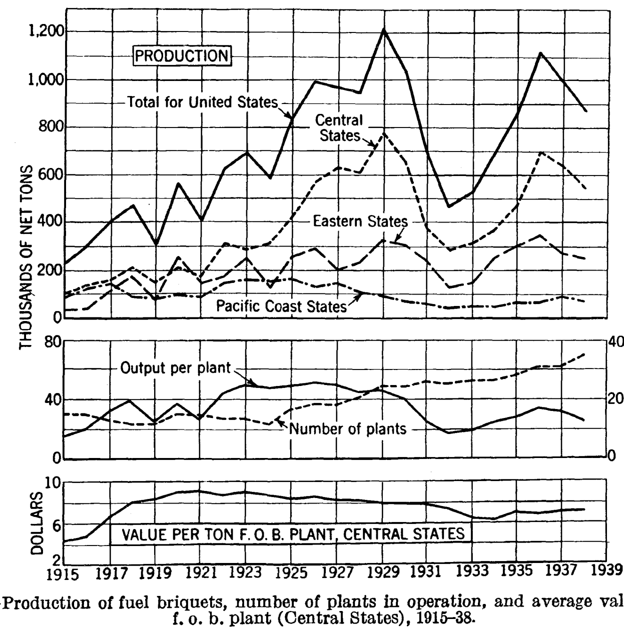

FIGURE 1.—Production of fuel briquets, number of plants in operation, and average value per net ton, f. o. b. plant (Central States), 1915–38.

Fuel briquets produced in the United States, 1937–38

	1937			1938				
	Plants	Net tons	Value	Plants	Net tons	Value	Percent of change in— Tonnage	Percent of change in— Value
Eastern States	4	270,451	$1,132,734	4	251,443	$1,090,055	−7.0	−3.8
Central States	22	636,352	4,463,788	25	545,848	3,917,936	−14.2	−12.2
Pacific Coast States	5	89,127	797,201	6	73,969	693,899	−17.0	−13.0
	31	995,930	6,393,723	[1] 35	871,260	5,701,890	−12.5	−10.8

[1] Includes 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.

The decrease in output of fuel briquets in the Eastern and Central States can be attributed to the mild winter of 1938. Production in the Pacific Coast States, although 17 percent below 1937, was about normal in 1938; production was unusually high in 1937 because of severe freezes in January of that year. The winter of 1938 was so mild that orchard heating—an important market for this fuel on the Pacific coast—was unnecessary.

Wisconsin produces about half the total; West Virginia, Pennsylvania, Oregon, and Missouri follow in order of tonnage produced in 1938. Michigan, Minnesota, Nebraska, Washington, West Virginia, and Wyoming increased their output in 1938.

The following table shows production and value for 1938 in those States for which the figures can be published without revealing operations of individual companies.

Fuel briquets produced in Wisconsin, North Dakota, Minnesota, and Washington

State	1937			1938		
	Plants	Net tons	Value	Plants	Net tons	Value
Minnesota	3	20,905	$162,136	3	22,840	$219,428
North Dakota	1	(1)	(1)	3	27,071	183,655
Washington	2	(1)	(1)	3	13,525	104,162
Wisconsin	10	507,462	3,639,183	10	422,281	3,085,873

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

Monthly production of fuel briquets in the United States, 1936–38, in net tons

Month	1936	1937	1938	Month	1936	1937	1938
January	146,469	140,969	141,397	August	53,454	43,389	51,098
February	209,765	92,816	79,414	September	78,889	87,153	78,128
March	68,593	47,872	36,556	October	129,829	128,266	87,446
April	40,870	36,541	28,806	November	134,250	113,809	99,651
May	45,421	71,077	49,599	December	127,810	135,894	120,351
June	52,638	57,936	61,531				
July	36,985	40,208	37,283		1,124,973	995,930	871,260

Value.—The total sales value of the briquets manufactured in 1938 was $5,701,890, f. o. b. plant, 11 percent below 1937. The loss in total value is due to the 12.5-percent decrease in production, as the average value per ton rose from $6.42 in 1937 to $6.54 in 1938.

The average for the entire industry is of doubtful significance because of variations in the cost of raw fuel to briquetting plants and in market prices of competing fuels.

The average value per net ton in the Eastern States in 1938 was $4.34, in the Central States $7.18, and in the Pacific Coast States $9.38. These figures do not represent the prices paid by the ultimate consumer.

In the Eastern States the entire output comes from plants in the low-volatile coal fields of southern West Virginia and in the anthracite region of Pennsylvania, where the cost of raw fuel does not involve freight charges. As a result, the f. o. b. value of briquets at these plants is relatively low. In the Central States most of the production comes from plants at coal docks on Lakes Michigan and Superior; the raw fuel for these plants involves a considerable freight charge.

Technical developments.—Interest continues in technical research and experimentation. However, no new methods were put into commercial operation in 1938, so far as is known, except at a plant in California where residual carbon from the pyrolysis [2] of natural gas is being used as raw fuel, with the addition of a 14-percent asphaltic pitch binder.

Attention is called to recent papers and discussion on the manufacture of fuel briquets by C. C. Morfit, C. A. Jacobson, and J. L. Knight.[3]

The appeal of packaged products has also penetrated the field of bulk briquets. Two new fuel-briquetting plants have included bagging machinery in their equipment. The product of both plants is the small pillow-shaped briquet, automatically sacked in bags of about 15 pounds and sold locally.

Another briquetting plant, making 3-inch cubes, wrapped several thousand tons (about one-third of its production) in 10-pound packages.

One of the larger briquetting operations, which makes Pennsylvania anthracite briquets, reports that retail dealers are bagging increasing quantities of its product in 17-, 25-, and 50-pound bags.

Number of plants.—Thirty-five plants reported commercial production in 1938, the largest number of active fuel-briquetting plants in the history of the industry. Of these, eight are new (one each in California, Michigan, Minnesota, Nebraska, Ohio, and Washington and two in North Dakota).

Three additional plants, situated in Michigan, Pennsylvania, and Texas, were under construction and in experimental operation in 1938.

Sixteen plants were idle in 1938, of which 13 were also idle in 1937. Seven plants went out of business in 1938, but two of these were active part of the year.

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[2] The chemical decomposition of substances by the action of heat.

[3] Morfit, C. C., Observations—Fuel Briquet Manufacture: Paper presented at the Second Annual Coal Conference, West Virginia University, Morgantown, W. Va., Nov. 11, 1938, and published in The Proceedings of the Second Annual Coal Conference, West Virginia Univ. Bull. Ser. 39, No. 8, February 1939, pp. 147–155.

Jacobson, C. A., Discussion of Mr. C. C. Morfit's Paper: West Virginia Univ. Bull. Ser. 39, No. 8, February 1939, pp. 156–159.

Knight, J. L., What Factors are Important in Briquetting?: Coal Age, vol. 43, No. 9, September 1938, pp. 34–35.

Size of plants.—The following table classifies the plants according to actual production as well as actual capacities; however, a better indication of the size of plants is gained from their capacity, even though the latter is definitely affected by seasonal variations in production.

The total annual capacity of the 35 plants operating in 1938, as reported by the operators, is 3,111,800 net tons, whereas production was only 871,260 tons. The estimated annual capacity of the eight new plants is about 107,500 tons.

Classification of briquetting plants in 1938, by size of output and annual capacity

Output (net tons)	Plants	Annual capacity (net tons)	Plants
Less than 2,000	11	Less than 5,000	3
2,000 and less than 5,000	4	5,000 and less than 10,000	5
5,000 and less than 10,000	5	10,000 and less than 25,000	8
10,000 and less than 25,000	5	25,000 and less than 100,000	12
25,000 and less than 100,000	8	100,000 and less than 200,000	2
100,000 and over	2	200,000 and less than 400,000	3
		400,000 and over	2
	[1] 35		[1] 35

[1] 16 plants operated 12 months of the year; 10 plants from 7 to 11 months; and 9 plants less than 5 months

Raw fuels.—The total quantity of raw fuel briquetted in 1938 was 836,407 net tons, of which low-volatile bituminous coal formed the greater part. Fourteen plants used 296,133 tons of low-volatile coal exclusively; the total low-volatile utilized amounted to 501,325 net tons—60 percent of the total raw-fuel tonnage.

Nine operators, using 371,139 tons of anthracite and bituminous coal, reported that the raw fuel was washed before it was manufactured into briquets.

Classification of fuel-briquetting plants by kinds of raw fuel used in 1938

Kind of raw fuel used:	*Plants*
Anthracite or semianthracite fines exclusively	3
Mixture of anthracite or semianthracite and bituminous	5
Bituminous:	
Low-volatile	14
High-volatile	[1] 2
Semicoke (lignite char)	3
Mixture of petroleum coke with anthracite or bituminous	3
Residual carbon from pyrolysis of natural gas	1
Residual carbon from manufacture of oil gas	2
Petroleum coke	2
	35

[1] 1 plant using high-volatile coal also reported using residual carbon from manufacture of oil gas.

Raw fuels used in making briquets in the United States, 1929 and 1936–38

	Net tons				Percent of total			
	1929	1936	1937	1938	1929	1936	1937	1938
Anthracite and semianthracite culm and fine sizes	408,967	296,806	252,572	200,347	34.4	27.8	26.5	23.9
Bituminous and subbituminous slack	711,459	645,896	569,815	505,917	59.9	60.6	59.9	60.5
Semicoke, coke, oil-gas residue, or petroleum coke	67,513	123,868	129,278	[1] 130,143	5.7	11.6	13.6	15.6
	1,187,939	1,066,570	951,665	836,407	100.0	100.0	100.0	100.0

[1] Includes residual carbon from pyrolysis of natural gas at plant in California.

Important factors that control the success of a briquetting plant are 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. As borne out in the following table, the plants drawing upon the nearby Lake docks for their raw fuel produced approximately half of the total output in 1938.

Fuel briquets produced in the United States, 1937–38, with reference to supply of raw fuel

Location of plant	Net tons		Change in 1938 compared with 1937	
	1937	1938	Net tons	Percent
At or near Lake Superior or Lake Michigan coal docks	507,462	422,717	−84,745	−16.7
At coal mines	325,093	292,827	−32,266	−9.9
At or near petroleum refineries and oil-gas plants	91,267	84,954	−6,313	−6.9
At other locations [1]	72,108	70,762	−1,346	−1.9
	995,930	871,260	−124,670	−12.5

[1] 1937—South Chicago, Ill.; Indianapolis, Ind.; Fall River, Mass.; Jackson, Mich.; Minneapolis and St. Paul, Minn.; Kansas City, Mo.; and Omaha, Nebr. 1938—Same as for 1937, except Indianapolis, Ind.

Binders and recarbonization.—Asphaltic pitch continues to be the most frequently used binder. Three plants (two using residual carbon from the manufacture of oil gas and one using low-volatile bituminous coal as their raw fuels) reported that no binder was used. The production of the coal plant was small, and all sales were local. One new plant in California, employing residual carbon from the pyrolysis of natural gas for its raw fuel, reported the use of 14 percent asphaltic pitch.

One producer using anthracite as raw fuel reported partial recarbonization to drive off smoke caused by the binder.

Classification of briquetting plants in 1938, by type and percentage of binder used

Type of binder	Plants	Percentage of binder to raw fuel (by weight)	Plants
Asphaltic pitch	24	Less than 5 percent	5
Coal-tar pitch	1	5 and less than 7 percent	16
Mixed pitches	2	7 and less than 9 percent	7
Petroleum asphalt	2	9 percent and over	4
Starch, asphalt, and water	1	No binder	[1] 3
Starch	2		
No binder	[1] 3		35
	35		

[1] Includes 2 plants using residual carbon from manufacture of oil gas and 1 plant using bituminous coal as raw fuel.

Weight and shape.—The industry has made virtually no change in the prevalent size and shape of fuel briquets. More than 90 percent of the total tonnage in each year since 1930—the first year for which the Bureau of Mines asked the producers to give information on weight, size, and shape—has consisted of briquets weighing less than 5 ounces.

Prevailing weight of briquets produced in 1938

Weight (ounces)	Plants	Production: Net tons	Production: Percent of total
Less than 2	5	57,107	6.5
2 and under 3	14	479,314	55.0
3 and under 4	5	245,426	28.2
4 and under 5	5	71,925	8.3
5 and under 6	1		
6 and under 10	1		
10 and under 16		17,488	2.0
16 and under 25	6		
42 and over	1		
	[1] 35	871,260	100.0

[1] 3 plants made briquets of more than 1 size, hence the sum of the items exceeds the number of active plants. Of the 8 new plants, 5 made briquets between 2 and 5 ounces and 3 between 16 and 42 ounces.

The pillow-shaped briquet continues to be the most popular. Of the 35 plants active in 1938, 25 made pillow-shaped briquets, 6 cubes, and 2 cylindrical. One plant reported making three different shapes—pillow, cube, and cylindrical; another plant made pillow and cylindrical shapes.

Principal expenses and value added by manufacture.—Data on the cost of manufacturing fuel briquets and packaged fuel are not collected by the Bureau of Mines.

Information on the principal items of expense (salaries; wages; cost of materials, fuel, electric energy, and contract work; value of product; and value added by manufacture) is collected and published by the Bureau of the Census in alternate years.

The Census classification of the fuel-briquetting industry includes only those establishments with an output valued at $5,000 or more in which briquets are the chief products made. The Bureau of the Census therefore excludes briquets produced at petroleum refineries or at city gas works, but the returns are representative of independent briquetting plants.

Data for 1937 are now available and may be obtained upon application to the Bureau of the Census, United States Department of Commerce, Washington, D. C.

Distribution.—In 1938 briquets were shipped to 35 States, the District of Columbia, Alaska, and Canada. Minnesota and Wisconsin consumed about 45 percent of the total, the same proportion as in 1937. States reporting the largest output in 1938 shipped their briquets as follows: From Wisconsin to 9 States; from West Virginia to 18 States and Canada; and from Pennsylvania to 15 States, the District of Columbia, and Canada. The States consuming all or most of their production locally were: Massachusetts, Illinois, Michigan, Minnesota, Nebraska, North Dakota, Ohio, California, Oregon, and Washington.

Particularly noteworthy was the single shipment on January 11, 1938, of about 5,000 tons of briquets in a solid train of 100 cars from Glen Rogers, W. Va., to Toledo, Ohio, for ultimate distribution to customers in Michigan cities.[4]

[4] Coal Heat, vol. 33, No. 2, February 1938, p. 68.

Fuel briquets of domestic manufacture consumed in the United States and exported to Canada, 1937–38, in net tons

Shipped into—	1937	1938	Shipped into—	1937	1938
Alaska	92	28	New Jersey	1,467	1,025
Arkansas	70	--------	New York	36,283	26,804
California	24,500	7,551	North Carolina	6,581	8,706
Connecticut	2,143	1,218	North Dakota	62,219	56,728
Delaware	342	163	Ohio	24,958	27,637
District of Columbia	753	418	Oregon	44,545	36,189
Florida	468	492	Pennsylvania	13,657	11,015
Georgia	172	28	Rhode Island	5,234	4,792
Idaho	307	1,340	South Carolina	765	16,654
Illinois	36,224	30,914	South Dakota	54,970	35,542
Indiana	10,433	11,985	Tennessee	201	--------
Iowa	25,618	23,618	Vermont	335	330
Kansas	6,224	4,212	Virginia	14,291	13,553
Kentucky	1,611	2,571	Washington	19,086	21,210
Maine	541	786	West Virginia	2,502	299
Maryland	2,467	2,602	Wisconsin	200,581	187,407
Massachusetts	30,524	28,971	Wyoming	--------	1,500
Michigan	48,859	59,827	Canada[1]	23,288	17,031
Minnesota	251,126	195,222			
Missouri	10,666	7,961		982,048	867,399
Nebraska	16,706	19,272			
New Hampshire	1,239	1,798			

[1] As reported by the operators to the Bureau of Mines; official figures on imports and exports are given in following tables.

In the questionnaire for 1938 the Bureau of Mines for the first time requested information on the tonnage shipped by rail, truck, and waterway. The results, given in the following table, indicate that 80 percent of the tonnage moved by rail and the rest by truck (including local deliveries).

Fuel-briquet shipments by rail and truck in 1938, in net tons

	Rail	Truck[1]	Total
Eastern States	246,673	3,449	250,122
Central States	423,246	127,215	550,461
Pacific Coast States	[2] 23,952	42,864	66,816
Total United States	693,871	173,528	867,399

[1] Includes local deliveries.
[2] Includes 28 tons subsequently shipped from Seattle, Wash., by water to Alaska.

Imports and exports.[5]—In 1938 imports of fuel briquets rose to 13,814 net tons all from Belgium and the Netherlands, and all entering Massachusetts, Maine, and New Hampshire. Exports dropped to 16,692 tons, valued at $123,309, of which all but 2 tons went to Canada.

Briquets (coal and coke) and other composition coals for fuels imported for consumption in the United States, 1934–38

Year	Net tons	Value	Year	Net tons	Value
1934	(1)	(1)	1937	6,674	$28,549
1935	16,779	$73,992	1938	13,814	67,366
1936	20,350	80,210			

[1] None reported in 1934.

[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.

Briquets (coal and coke) exported from the United States, 1937–38, by countries and customs districts [1]

Country	1937 Net tons	1937 Value	1938 Net tons	1938 Value
Canada	25,123	$164,357	16,690	$123,278
Cuba	126	1,006	------	---------
Guatemala	2	40	------	---------
Mexico	30	359	2	31
United Kingdom	69	607	------	---------
	25,350	166,369	16,692	123,309

Customs district	1937 Net tons	1937 Value	1938 Net tons	1938 Value
Buffalo	19,210	$120,711	11,832	$87,170
Dakota	195	1,967	(2)	10
Duluth and Superior	180	1,604	79	699
Maine and New Hampshire	------	--------	30	246
Maryland	10	127	------	-------
Massachusetts	(2)	19	------	-------
Michigan	1,500	9,643	941	4,511
New Orleans	204	1,837	------	-------
New York	11	30	1	38
St. Lawrence	3,793	28,246	3,482	27,662
San Diego	2	18	2	31
Washington	245	2,167	325	2,942
	25,350	166,369	16,692	123,309

[1] Exports not reported separately by Bureau of Foreign and Domestic Commerce prior to 1937.
[2] Less than 1 ton.

World production.—World data for 1938 are incomplete, but the available statistics, with virtually complete data for the preceding years, are given in the following table.

World production of fuel briquets, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
Algeria	73,340	73,200	60,885	68,682	(2)
Australia: Victoria [3]	328,807	292,866	363,340	396,760	420,704
Belgium	1,353,530	1,368,610	1,559,890	1,849,280	1,702,470
Bulgaria	19,534	43,015	41,802	47,106	85,770
Czechoslovakia:					
Coal	386,463	408,539	414,896	459,680	(2)
Lignite	194,893	188,466	189,304	264,482	(2)
Eire (Irish Free State)	(2)	(2)	2,745	10,725	(2)
France	7,946,820	7,998,500	8,518,480	7,957,000	(2)
Germany: [4]					
Coal	5,193,279	5,567,508	6,044,310	6,785,537	6,897,245
Lignite	31,384,338	32,837,070	36,074,489	41,951,141	44,007,268
Saar	6,105	(4)	(4)	(4)	(4)
Hungary:					
Coal } Lignite }	328,208	334,766	317,916	373,519	(2)
Indochina	62,231	71,118	104,644	132,225	(2)
Italy	18,290	38,710	46,533	58,860	(2)
Netherlands:					
Coal	1,087,145	1,087,349	1,119,585	1,277,305	1,262,716
Lignite	33,996	31,352	31,190	49,539	60,543
Netherland India	34,673	46,263	56,347	55,349	(2)
New Zealand	8,809	10,669	21,445	31,582	(2)
Poland	215,008	192,288	167,416	209,347	222,531
Portugal	[5] 311	[5] 170	[5] 850	7,772	19,865
Rumania	121,766	239,033	220,461	253,302	(2)
Spain	837,292	814,316	(2)	(2)	(2)
Tunisia	62,940	58,696	79,138	82,805	(2)
Turkey	(2)	(2)	(2)	14,761	(2)
United Kingdom	891,303	870,786	725,234	826,600	507,415
United States	639,431	[6] 803,717	[6] 1,080,814	[6] 1,035,970	[6] 936,402
Yugoslavia	23,533	18,365	13,350	61,323	100,945
	[7] 51,252,045	[7] 53,395,372	[8] 57,255,064	[9] 64,260,652	(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] Beginning with March 1935, production of the Saar is included with that of Germany.
[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.
[7] Exclusive of Eire (Irish Free State) and Turkey.
[8] Exclusive of Spain and Turkey.
[9] Exclusive of Spain.

PACKAGED FUEL

The production of packaged fuel continues to expand and apparently has definitely passed the pioneering stage. In 1938, 76 plants produced 160,952 tons valued at $1,405,253—three times as many active plants as in 1935 and nearly three times the value reported in 1936. The increase over 1937 was 14,915 tons (10 percent).

Of the 76 plants, 67 are in the Central States; Michigan, Ohio, Wisconsin, and Minnesota are the most important producing States.

Packaged fuel is manufactured principally for local or nearby consumption, but five operators, whose plants are located at docks on the Great Lakes, reported shipments by rail in 1938 of about 5,000 tons to points within a radius of 500 miles.

The National Association of Packaged Fuel Manufacturers held its second meeting in Chicago on September 15, 1938. A discussion of this meeting in Packaged Fuel News [6] stated that the technical problems confronting the industry have been largely overcome and that further expansion is expected through cooperation of its members in aggressive merchandising methods.

Numerous inquiries from foreign countries indicate interest in the manufacture of packaged fuel abroad. According to an established packaged-fuel machine manufacturer, however, difficulties in arranging for overseas shipment of machinery and other necessary supplies have interfered with the foreign sales of such equipment.

Production and value.—The following table summarizes the production and value received at the plant for the packaged fuel manufactured in the United States, 1937–38.

Packaged fuel produced in the United States, 1937–38, by States

[The plants and production reported in this table are not included in the preceding fuel-briquet tables]

State	1937			1938		
	Plants	Net tons	Value	Plants	Net tons	Value
Central States:						
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	5	3,153	$31,820	5	4,133	$42,555
Indiana	4	10,940	86,181	5	12,060	87,667
Iowa	1	(1)	(1)	2	(1)	(1)
Michigan	15	54,259	467,655	21	60,676	509,779
Minnesota	4	12,599	144,107	6	14,304	162,746
Nebraska	1	(1)	(1)	1	(1)	(1)
Ohio	18	30,873	250,826	17	31,522	256,489
Wisconsin	7	16,909	139,108	9	24,662	210,473
Undistributed [2]		7,781	75,980		4,959	49,880
Total Central States	56	136,514	1,195,677	67	152,316	1,319,589
Eastern and Pacific Coast States [1]	[3] 8	9,523	91,643	[4] 9	8,636	85,664
Total United States	64	146,037	1,287,320	76	160,952	1,405,253

[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 3, Oregon, 1, Washington 1.
[4] Maine 2, Pennsylvania 1, Virginia 4, Oregon, 1, Washington 1.

[6] Packaged Fuel News, October 1938 (published by the National Association of Packaged Fuel Manufacturers, Harry Turner, secretary, 700 Quincy St., Topeka, Kans.

December and July, respectively, continue to be the high and low months of production in the packaged-fuel industry. In month to month comparisons, however, it should be remembered that a number of new plants started operating in the latter part of both 1937 and 1938.

Monthly production of packaged fuel in the United States in 1937–38, in net tons

Month	1937	1938	Month	1937	1938
January	15,344	22,095	August	2,131	2,252
February	15,076	17,124	September	10,377	13,198
March	16,439	15,710	October	21,164	19,671
April	15,286	13,673	November	21,976	23,271
May	4,321	7,074	December	22,253	25,323
June	972	789			
July	698	772		146,037	160,952

The figures in the following table represent the value received per ton at the plant in the States for which this information can be shown separately. The values reported by the individual operators show a higher return per ton where considerable tonnage was sold in less than quarter-ton lots.

Average value per net ton of packaged fuel sold in the United States, 1937–38, by States

State	1937	1938	State	1937	1938
Eastern States	$9.81	$9.62	Central States—Continued.		
Central States:			Ohio	$8.12	$8.14
Illinois	10.09	10.30	Wisconsin	8.23	8.53
Indiana	7.88	7.27	Central States average	8.76	8.66
Michigan	8.62	8.40	Pacific Coast States	(1)	(1)
Minnesota	11.44	11.38	United States average	8.82	8.73

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

Processes.—Of the 76 operations in 1938, 72 used the Eberling process [7] described in previous reports of this series. The other four operations are outlined briefly in the following paragraphs.

The Johnson Coal Cubing Co.,[8] of Detroit, Mich., uses a process and equipment of its own design, producing a cube-shaped briquet wrapped in heavy paper, eight to the package. This company, which is the largest of the packaged-fuel operations, started production in 1932.

A new plant in Grand Rapids, Mich., reported the first installation of a machine that produces bricks (6½ by 3½ by 4 inches) which are hand-packed three to a paper bag and weigh 10 to 11 pounds.

A new plant in Minneapolis, Minn., which started operations late in 1938 with still another type of machine, uses asphalt binder instead of the cornstarch usually employed in the manufacture of packaged fuel. Eight 3-inch cubes to the package are automatically wrapped in heavy paper by a specially designed wrapping machine with a capacity of 40 packages per minute or 12 tons per hour.

[7] Packaged Fuel by the Eberling Process: 1938 catalog issued by C. M. Eberling, 6002 Ellen Avenue, Cleveland, Ohio.
[8] The Black Diamond, vol. 102, No. 7, Apr. 8, 1939, p. 23.

A new plant operated by eight local coal yards in Fort Wayne, Ind., has installed a machine of the tamp type that produces 4-inch cubes, which are paper-wrapped, four to the package.

Number of plants.—Of the 76 active plants in 1938, 16 reported operations for the first time. All but one of the new plants are in the Central States region. Eight plants were idle in 1938; several of these found it more profitable to buy the packaged fuel from other manufacturers for resale. One company went out of business in 1938.

Size of plants.—Sixty-one of the 76 packaged-fuel plants active in 1938 produced less than 3,000 tons each during the year; 16 of these were new (of which five operated 12 months and 11 but a few months in 1938). Reports submitted on individual capacities indicate that the 76 plants were equipped to produce (if necessary to supply the demand) an annual total of about 500,000 tons.

Classification of packaged-fuel plants in 1938, by size of output and annual capacity

Output (net tons)	Plants	Annual capacity (net tons)	Plants
Less than 500	17	2,000 and less than 5,000	38
500 and less than 1,000	14	5,000 and less than 10,000	26
1,000 and less than 3,000	30	10,000 and less than 15,000	6
3,000 and less than 5,000	10	15,000 and less than 25,000	2
5,000 and less than 10,000	3	30,000 and less than 40,000	3
10,000 and less than 25,000	1	40,000 and less than 60,000	----------
25,000 and over	1	60,000 and over	1
	[1] 76		[1] 76

[1] 12 plants operated 12 months of the year; 49 plants, 6 to 11 months; and 15 plants, 1 to 5 months (11 of these new in 1938).

Raw fuels.—The tendency in 1937 toward the use of shipped-in slack from the mines and Lake docks as raw fuel in the manufacture of packaged fuel became more prevalent in 1938, when 46 out of 76 plants used shipped-in slack exclusively; 15 plants used both shipped-in slack and yard screenings and 12 plants yard screenings exclusively. Four operators did not reply to this question.

The principal raw fuel is bituminous low-volatile slack, which was used exclusively by 67 operators; 1 operator used bituminous high-volatile slack, 3 petroleum coke, 1 semianthracite, and several operators used mixtures of these various fuels.

Binders.—Cornstarches remain the principal binders used. Two operators reported using cement, one asphaltic pitch, and one glue.

PEAT

By F. M. Shore

SUMMARY OUTLINE

The commercial production of peat and peat humus in the United States declined materially in 1938, according to reports courteously furnished by producers to the Bureau of Mines. The total production amounted to 45,933 short tons valued at producing plants at $286,127, a reduction of 10 percent in tonnage and 6 percent in value from 1937. Imports of peat moss also declined substantially in 1938 to 69,509 short tons valued at $1,092,942 as against 86,871 tons valued at $1,219,127 in 1937, a loss of 20 percent in quantity and 10 percent in value. The total quantity of peat and peat humus available for domestic consumption in 1938 (domestic production plus imports) was 115,442 short tons, a reduction of 16 percent from 1937. The downward trend in peat production in 1938 was in line with, but less than, the drop in industrial production generally. It will be noted, however, that the average value per ton of peat in 1938 was larger than in 1937, as well as that of peat-moss imports.

Reserves.—The total quantity of peat in the United States, exclusive of Alaska, calculated as air-dried peat, has been estimated at 13,827,-000,000 short tons.[1] The area of the lands that contain peat deposits probably exceeds 100,000,000 acres. The bulk of the peat reserves is in the States of the Upper Lakes region—Minnesota, Wisconsin, and Michigan together having about 75 percent of the total. Substantial deposits of peat occur in other States bordering the Great Lakes and the Atlantic and Pacific coasts. About half the States contain some peat, but not all of the deposits can be developed economically.

The texture and quality of peat deposits and the value of the peat for specific uses may vary greatly because of different plant origins, conditions under which the deposits were formed, and stages of development. The various factors individual to each peat deposit, including its potential markets, character, and circumstances of deposition, must be studied carefully before its possibilities for profitable development can be determined.

Production.—Figure 1 shows the annual production of peat in the United States since the industry attained commercial importance.

The quantity and value of the domestic output of peat in recent years are given in the following table.

[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, 1926 and 1934–38 [1]

Year	Short tons	Value	Year	Short tons	Value
1926	61,936	$364,413	1936	46,126	$266,883
1934	40,544	214,185	1937	51,223	305,156
1935	37,060	199,377	1938	45,933	286,127

[1] No canvass 1927–33, inclusive.

Output of peat in 1938 was reported by 39 producers operating plants in 14 States. The same States produced peat in 1938 as in 1937, but there were three less producers. The 1938 production totaled 45,933 short tons valued at $286,127. In 1938, as in 1937, New York and New Jersey were the largest producing States. Other States reporting commercial production of peat, in order of output,

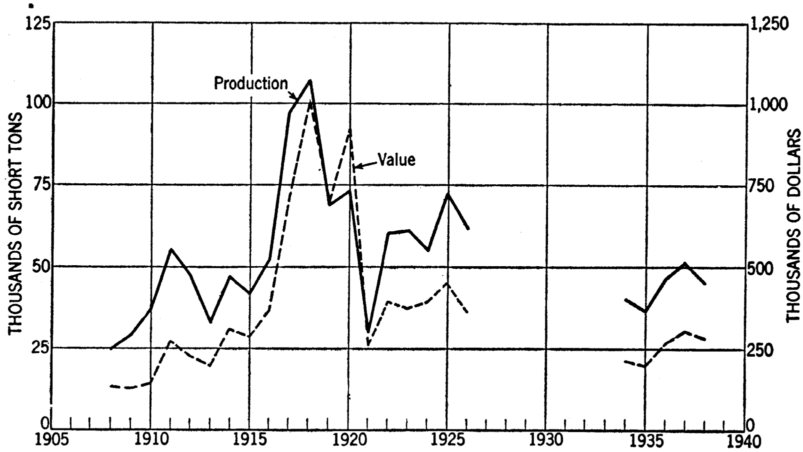

FIGURE 1.—Quantity and value of peat production, 1908–38. No data are available for the period 1927–33.

were Michigan, California, Florida, Ohio, Colorado, Minnesota, Iowa, Washington, Pennsylvania, New Hampshire, Maine, and Massachusetts. The production from some of these States was of little economic consequence, and the wide distribution of producing operations is more significant of the scope and potential value of peat resources and possible future markets than it is of present utilization. Approximately 58 percent of the production in 1938 was peat humus, about 32 percent reed and sedge peat, and the remainder moss and various other kinds of peat. Twelve States produced peat humus, five reed or sedge peat, and seven moss peat. Two plants reported the production of kiln-dried peat, 7 of cultivated peat, 27 of shredded peat, and 16 of raw peat.

The Bureau of Mines attempts to report only the commercial production of peat; however, this tonnage does not represent the total utilization of domestic peat in the United States. Some municipalities operate peat plants for their own needs, such as to improve the soils of lawns and parks, and many owners of land containing peat or muck soils use them for growing vegetables or other crops.

Data showing the area of peat and muck soils under cultivation are not available, but the total amounts to many thousands of acres. It should be noted that such use of peat is an important factor in economic utilization of the national peat resources.

Uses.—Peat can be used for many purposes, but its use in this country is confined largely to improvement of soils, directly as a soil conditioner or an ingredient of fertilizers or indirectly as a compost with animal or vegetable refuse. The producers of peat were asked to report, in connection with their 1938 production, the quantity of peat sold for use in mixed fertilizers, but the reports were too incomplete to warrant publication. Peat is employed to some extent as a packing material for the shipment of plants, vegetables, fruits, or fragile articles and as an insulating material. Its chief use is for improving soils for growing vegetables, fruits, flowers, trees, shrubbery, and grass; in gardens, nurseries, and greenhouses; and on lawns, golf courses, and parks. The reports of peat and peat-humus sales in 1938 indicated that 76 percent was sold for soil improvement. Other uses reported were stable and poultry litter and packing material. In many European countries peat is used widely as a domestic fuel, and in some of them substantial quantities are used for industrial fuel. In the United States peat cannot compete under present conditions with high-grade fuels that are so widely available. No sales of domestic peat for fuel have been reported in recent years.

Imports.[2]—Imports of peat moss in 1938 decreased in total quantity and value from the 1937 record, although the average value per ton was greater than in 1937. The tonnage was 20 percent and the total value of imports 10 percent below 1937 figures. The chief sources of imports of peat moss in 1938 were, in order of tonnage, Germany, Sweden, the Netherlands, and Canada. Imports from Canada showed a substantial gain, continuing the upward trend that began in 1934.

Imports of peat moss into continental United States were received through 25 customs districts, indicating the wide geographical distribution of its use. Most of the imports (approximately 63 per cent) were received at Atlantic coast ports, although some 10,000 tons entered through Gulf ports and 14,000 tons through Pacific ports.

The average value per ton of peat-moss imports increased again in 1938, continuing a trend that has prevailed for several recent years. It was $10.74 in 1933, $12.40 in 1934, $12.42 in 1935, $12.73 in 1936, $14.03 in 1937, and $15.72 in 1938. The average value reported varies considerably with the country of origin. For example, imports from Canada in 1938 were $22.85 per ton, Latvia $21.30, Sweden $18.66, Germany $14.45, and the Netherlands $9.83.

Peat moss imported for consumption in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	44,132	$547,353	1937	86,871	$1,219,127
1935	54,547	677,513	1938	69,509	1,092,942
1936	75,066	955,807			

[2] 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, 1937–38, by countries

Country	1937		1938	
	Short tons	Value	Short tons	Value
Belgium	323	$6,024		
Canada	2,974	68,730	3,989	$91,167
Denmark	1,009	16,839	1,239	17,293
Estonia	1,139	20,018	1,486	26,514
Finland			77	1,659
Germany	52,928	630,218	36,381	525,564
Japan	83	1,701		
Latvia	1,414	23,582	1,604	34,166
Netherlands	5,018	65,501	6,709	65,968
Norway	968	18,604	744	13,325
Poland and Danzig			222	3,145
Sweden	19,058	338,962	15,127	282,284
U. S. S. R.	1,250	17,918	1,433	25,455
United Kingdom	707	11,030	498	6,402
	86,871	1,219,127	69,509	1,092,942

World production.—It is difficult to obtain comprehensive and current data regarding world production of peat. Apparently some peat-producing countries do not compile data showing the quantities produced, and the units of quantity used by countries that do report production are not uniform. The data in the following table, although not complete, will prove of interest to those concerned with the production and use of peat, as they represent the latest information now available.

World production of peat in 1936, by countries

[Compiled by M. T. Latus]

Country	1936	Country	1936
Argentina metric tons	(1)	Lithuania metric tons	124,000
Austria do	(1)	Netherlands do	(1)
Canada (fuel) do	1,217	Norway do	(1)
Denmark do	(1)	Poland do	(1)
Eire do	(2)	Sweden:	
Estonia do	106,659	Fuel do	30,743
Finland do	(3)	Litter, baled do	109,349
France do	17,050	Litter and "mull," unbaled cubic meters	37,067
Germany do	(1)	"Mull," baled metric tons	35,916
Hungary do	(1)	Switzerland do	7,000
Italy do	3,194	United States do	41,845
Latvia:		U. S. S. R. do	[4] 22,286,000
Litter cubic meters	46,127		
Waste do	15,876		
Insulation do	1,604		

[1] Data 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 peatmoss litter and peat mull are manufactured annually in Ireland, 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] 18,249 metric tons, 231,661 bales, and 8,201 cubic meters; equivalent in metric tons not available.
[4] Estimated.

CRUDE PETROLEUM AND PETROLEUM PRODUCTS [1]

By A. G. White, G. R. Hopkins, and H. A. Breakey

SUMMARY OUTLINE

The relative proportion contributed by the United States to world oil production fell from 62.7 percent in 1937 to 61.3 percent in 1938. The 1938 decline of 66 million barrels in United States crude oil production, owing to depressed domestic demand and efforts to reduce crude and refined stocks to more economic levels, was offset by an increase of only 2 million barrels for all other world producers combined. Consequently, total world production fell from 2,042 million barrels in 1937 to 1,978 million in 1938, a decrease of 64 million. Increases of 7 million barrels in Russian output, 4 million in Canada, and smaller gains in other producing countries were largely balanced by the decline of 12 million barrels in Mexican production that resulted from expropriation of oil properties by the Government and the decline of 4 million barrels in Rumanian output.

The total exports of crude and refined products from continental United States rose from 173 million barrels in 1937 to 194 million in 1938, while total imports fell from 57 to 54 million. This substantial gain in net exports was due in part to the accumulation of strategic stocks abroad.

The combined domestic and export demand for all oils in 1938 decreased about 14 million barrels from the 1937 all-time peak of 1,342 million. As exports of all oils increased 21 million barrels, domestic demand was reduced by 35 million barrels. A decline of 9 percent (30 million barrels) in the total demand for residual fuel oils was the major feature in 1938.

Although the drop in the total volume of the oil industry's business was only a little over 1 percent, slight progress was made in reducing

[1] Data for 1938 are preliminary; detailed statistics with final revisions will be released later.

the excessive inventories accumulated in 1937, and prices of refined products trended steadily downward during the year, followed by a sharp break in crude prices in October. Many small refineries were closed when operations became unprofitable, and the net profits of many of the larger integrated companies were sharply reduced.

The following table shows the trend in the demand for all oils since 1929.

Total demand for all oils, 1929–38

[Millions of barrels]

Year	Domestic demand	Exports	Total demand	Year	Domestic demand	Exports	Total demand
1929	940.1	163.1	1,103.2	1934	920.2	114.5	1,034.7
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]	1,134.2	193.9	1,328.1

[1] Subject to revision.

The sharp, unexpected drop in the upward trend of demand in the last quarter of 1937 resulted in a rapid increase in total stocks that was augmented in the first quarter of 1938, before the domestic industry could adjust itself to the change in market demand. Subsequent efforts to reduce inventories to a more normal level represent a dominant factor in operations during the remainder of the year.

Stocks of all oils were reduced by 10 million barrels in 1938, representing a decline of 29 million barrels in crude stocks and an increase of 19 million barrels in refined stocks. The decrease in crude stocks was due to active proration control by various State conservation agencies in an effort to correct the excessive inventories of all oils. This effort was largely offset by refinery operations on a larger scale than was necessary to meet demand. The position of total stocks east of California was improved by a total reduction of 41 million barrels, of which 39 million represented crude oil and only 2 million refined oils. Total stocks of California oils increased by 31 million barrels, of which 10 million represented crude oil and 21 million, refined products.

Salient statistics of crude petroleum, refined products, and natural gasoline, 1934–38

	1934	1935	1936	1937	1938 [1]
Crude petroleum:					
Domestic production ... thousands of barrels [2]	908,065	996,596	1,099,687	1,279,160	1,213,254
World production ... do	1,521,474	1,654,951	1,804,925	2,041,715	1,978,340
United States proportion of world production ... percent	60	60	61	63	61
Imports [3] ... thousands of barrels [2]	35,558	32,239	32,327	27,484	26,412
Exports [4] ... do	41,127	51,430	50,313	67,234	77,273
Stocks, end of period:					
Refinable crude ... do	[5] 337,254	[5] 314,855	[5] 288,579	[5] 306,826 [6] 305,091	274,353
California heavy crude ... do	(7)	(7)	(7)	14,505	16,467
Runs to stills ... do	895,636	965,790	1,068,570	1,183,440	1,165,015
Total value of domestic production at wells ... thousands of dollars	904,825	961,440	1,199,820	1,513,340	1,390,000
Average price per barrel at wells	$1.00	$0.97	$1.09	$1.18	$1.15
Total producing oil wells in the United States, Dec. 31	333,070	340,990	349,450	363,030	(7)
Total oil wells completed in the United States during year	12,512	15,108	17,800	22,143	19,121

See footnotes at end of table.

Salient statistics of crude petroleum, refined products, and natural gasoline, 1934–38—Continued

	1934	1935	1936	1937	1938 [1]
Refined products:					
Imports [4] .... thousands of barrels [2]	14,936	20,396	24,777	29,673	27,736
Exports [4] .... do	73,380	77,557	81,681	105,600	116,633
Stocks, end of period .... do	[5] 222,682	[5] 223,361	[5] 226,595	[5] 253,413 [6] 239,632	259,613
Output of motor fuel .... do	423,801	468,021	516,266	571,727	567,905
Yield of gasoline .... percent	43.4	44.2	44.1	43.9	44.3
Completed refineries, end of year	631	632	572	551	(7)
Daily crude-oil capacity of refineries thousands of barrels [3]	4,059	4,117	4,295	4,351	(7)
Average tank-wagon price (excluding tax) of gasoline in 50 United States cities cents per gallon [8]	12.26	12.02	12.63	[9] 10.53	[9] 10.43
Natural gasoline:					
Production .... thousands of barrels [3]	36,556	39,333	42,770	49,177	50,317
Stocks, end of period .... do	4,216	3,698	4,055	4,758	4,830

[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] American Petroleum Institute.
[9] Dealer's net. Comparable tank-wagon prices are no longer available.

There was virtually no change in the demand for foreign crude petroleum, as runs to stills remained the same in spite of a decline in imports.

The total demand for domestic crude in 1938 fell 20 million barrels from that of the previous year. An increase of 10 million barrels in exports indicated a decline of 30 million barrels in the internal demand for domestic crude. This amount represented a decrease in 1938 of about 18 million barrels in runs to stills and of 12 million in crude used for fuel and losses. The recession in the latter item may have been due to substantial reductions in the price of residual fuel oil, while the price of crude oils remained unchanged until late in the year.

With a decline of 66 million barrels in the total production of crude petroleum in the United States, the relative position of the States producing over 10 million barrels changed extensively in 1938. Texas, California, and Oklahoma continued to rank as the three leading producers, but their percentage of the total fell from 76 percent in 1937 to 74 percent in 1938. Production in Texas decreased 35 million and in Oklahoma 54 million barrels, and production in California increased 11 million. The increase of 16 million barrels in Illinois production raised the rank of the State from eleventh in 1937 to seventh in 1938.

The more important trends of the year are indicated by a brief analysis of major operations by quarters.

During the first quarter of 1938 total demand for all oils was about 1 percent greater than for the same period in 1937. Actually, this represented a figure far below expectations, with the result that production and refinery operations exceeded requirements, and about 5 million barrels were added to crude stocks and 18 million to refined stocks. By the end of March stocks of finished and unfinished gasoline had reached an all-time record of over 92 million barrels. The demand for residual fuel oil was 12 percent below that in the first quarter of

1937, and the demand for gas and distillate fuels was virtually unchanged. The situation was improved somewhat by a gain over the same period in 1937 of 7 million barrels in crude exports.

In the second quarter of 1938 compared to the same period of 1937 the demand for all oils declined by 8 million barrels and stocks of all oils were reduced 15 million barrels, mostly crude. The domestic demand for motor fuel dropped 1 million barrels but was offset by a gain of 3 million in exports. The total demand for residual fuel oils declined 15 percent from 1937.

In the third quarter the demand for all oils was 16 million barrels less than for the same period in 1937. Stocks of crude oil were reduced by over 10 million barrels, while stocks of other products increased about 3 million. The total demand for motor fuel was about 3 million barrels less than in 1937, unfavorable weather conditions in July and September being an important factor. The demand for residual fuel oils was still 12 percent below that of the previous year.

In the fourth quarter of 1938 the demand for all oils was 7 million barrels greater than for the same period in 1937. Although part of this increase may be due to the fact that a sharp downward trend was evident in that period in 1937, it also is evidence of the beginning of a substantial improvement in the trend of demand in 1938. Total stocks of all oils decreased 21 million barrels during the quarter, of which 9 million represented crude and 12 million, other oils. Total motor fuel demand was 8 million barrels greater than in 1937, an increase of 5 million in domestic demand, partly due to favorable weather conditions, and of 3 million in exports. As compared to 1937, increased demand and restricted refinery operations resulted in a substantial improvement in the position of gasoline stocks. The demand for residual fuel oils rose 3 percent, and there was a substantial decrease in residual stocks. The improved trend of demand in this quarter continued in the early part of 1939.

In reviewing the demand for particular products in 1938, the outstanding features were a moderate increase in total motor-fuel demand, a sharp reduction in the demand for residual fuel oils, a stationary market for gas and distillate fuel oils and kerosene, and a decline in the demand for lubricants.

The total demand for motor fuel attained a new record of 572 million barrels in 1938, a gain of 14 million from 1937. Larger exports accounted for 12 million barrels of the increase, while domestic demand was only 2 million greater. The gain of about 14 million barrels of finished and unfinished gasoline stocks in 1937 was only partly offset by a decline of 5 million in 1938. High inventories combined with the modest increase in demand created an unstable price situation throughout the year, resulting in unprofitable refinery operations in many districts. The yield of gasoline from crude rose from 43.9 percent in 1937 to 44.3 percent in 1938, due in part to the adoption of improved refinery methods of recovery and in part to the combination of larger runs than necessary, with a weak market for residual fuel oils.

The total demand for residual fuel oils in 1938 decreased over 30 million barrels from 1937. As exports increased by almost 3 million barrels, this loss was entirely in the domestic market. Stocks of residual fuel oils increased by 16 million barrels during 1938, a gain of 17 million barrels in California and a decline of 1 million in the districts east of California. The large increase in California stocks was due to excess production of crude oil that was run to stills, with a corresponding production of refined products above market demand. In the area east of California very little progress was made in liquidating the large excess of residual stocks accumulated in 1937. However, improved industrial demand, combined with lower prices for residual fuel in the last quarter of 1938 and the first quarter of 1939, promised to reduce these excessive inventories in the central and eastern districts.

The total demand for gas oil and distillate fuel oils in 1938 was virtually the same as in 1937, both for domestic demand and export. The year ended with an increase of 5 million barrels in inventories. A considerable part of this increase represented the return of California stocks to a more normal position. Comparatively mild weather in the first and fourth quarters of 1938 reduced the expected increase in the demand for heating oils, while transportation and industrial requirements were generally reduced by less favorable industrial conditions.

The total demand for kerosene in 1938 was practically the same as in 1937, with a gain of about 1 million barrels in domestic demand and a corresponding decrease in exports.

The total demand for lubricants was 11 percent less than in 1937. Domestic demand declined by 2 million barrels in 1938, while exports also decreased.

The long-term trends in supply and demand are shown in figure 1.

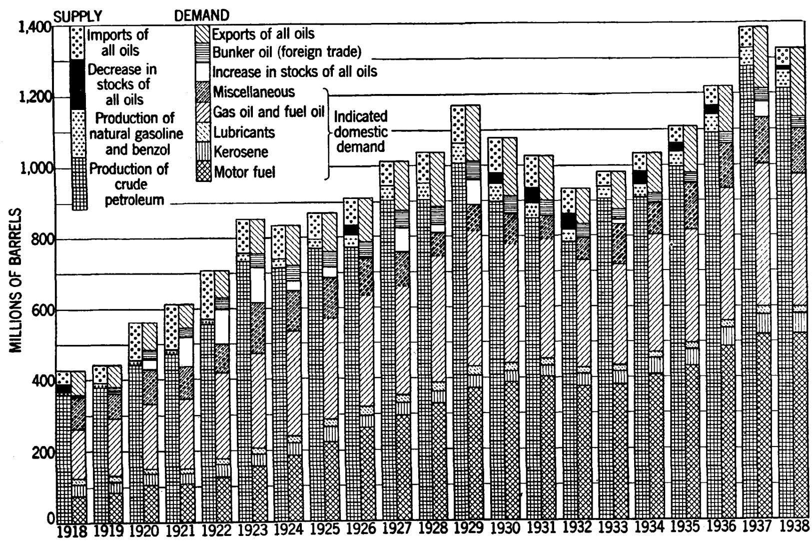

FIGURE 1.—Supply and demand of all oils, 1918–38.

Supply and demand of all oils in 1938, by months

[Including wax, coke, and asphalt in thousands of barrels]

	1938 [1]													1937 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
New supply:														
Domestic production:														
Crude petroleum	106,007	94,662	106,524	102,702	98,674	94,277	102,898	106,165	98,661	101,830	98,567	102,287	1,213,254	1,279,160
Daily average	3,420	3,381	3,436	3,423	3,183	3,143	3,319	3,425	3,289	3,285	3,286	3,300	3,324	3,505
Natural gasoline	4,336	3,889	4,326	4,171	4,196	4,001	4,127	4,226	4,081	4,375	4,244	4,345	50,317	49,177
Benzol	147	132	143	128	117	105	114	133	144	169	181	186	1,699	2,790
Total production	110,490	98,683	110,993	107,001	102,987	98,383	107,139	110,524	102,886	106,374	102,992	106,818	1,265,270	1,331,127
Daily average	3,564	3,524	3,580	3,567	3,322	3,279	3,456	3,565	3,430	3,431	3,433	3,446	3,466	3,647
Imports: [2]														
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	27,484
Refined products	2,122	1,679	2,325	2,361	1,940	2,559	2,203	2,953	2,676	2,148	2,264	2,506	27,736	29,673
Total new supply, all oils	114,707	102,245	115,887	111,189	107,008	103,134	111,907	115,191	107,136	111,215	107,615	112,184	1,319,418	1,388,284
Daily average	3,700	3,652	3,738	3,706	3,452	3,438	3,610	3,716	3,571	3,588	3,587	3,619	3,615	3,804
Change in stocks, all oils	+11,293	+7,300	+5,650	+3,891	−1,651	−6,962	+463	−4,711	−3,305	−5,926	−6,994	−7,771	−8,723	+45,768
Demand:														
Total demand	103,414	94,945	110,237	107,298	108,659	110,096	111,444	119,902	110,441	117,141	114,609	119,955	1,328,141	1,342,516
Daily average	3,336	3,391	3,556	3,577	3,505	3,670	3,595	3,868	3,681	3,779	3,820	3,870	3,639	3,678
Exports: [2]														
Crude petroleum	5,953	5,328	6,121	7,553	7,798	7,424	7,250	7,003	5,577	6,780	5,602	4,884	77,273	67,234
Refined products	7,988	8,605	9,204	10,427	10,681	10,338	10,054	10,763	9,487	9,388	8,461	11,237	116,633	105,600
Domestic demand:														
Motor fuel	35,176	31,861	41,259	43,254	44,911	48,293	47,474	50,459	46,058	46,272	44,991	41,649	521,657	519,352
Kerosene	5,360	5,017	5,150	4,333	3,637	3,257	3,752	4,292	4,187	5,185	5,368	6,813	56,351	54,972
Gas oil and distillate fuel oils	12,642	11,651	10,487	7,800	7,050	5,490	7,863	7,737	8,627	10,089	11,472	15,656	116,564	116,841
Residual fuel oils	25,844	23,627	25,696	22,279	22,447	22,278	20,548	23,775	23,082	25,666	27,621	29,787	292,650	325,514
Lubricants	1,471	1,311	2,195	1,591	1,730	1,606	1,844	2,002	2,127	1,805	1,735	1,831	21,248	23,323
Wax	115	82	90	101	92	85	75	81	69	72	71	61	994	1,062
Coke	535	416	308	313	422	573	445	473	636	442	520	506	5,589	5,765
Asphalt	1,077	883	1,444	1,654	2,203	2,675	2,799	3,201	3,017	2,701	1,745	1,132	24,531	21,876
Road oil	151	168	131	208	593	1,274	1,469	1,581	1,098	706	222	174	7,775	7,954
Still gas (production)	4,937	4,428	4,901	5,073	5,542	5,387	5,730	5,753	5,287	5,356	5,083	4,933	62,410	64,218
Miscellaneous oils	137	132	137	166	143	157	177	158	131	149	144	145	1,776	2,249
Losses and crude as fuel	2,028	1,436	3,114	2,546	1,410	1,259	1,964	2,624	1,058	2,530	1,574	1,147	22,690	26,556
Total domestic demand	89,473	81,012	94,912	89,318	90,180	92,334	94,140	102,136	95,377	100,973	100,546	103,834	1,134,235	1,169,682
Daily average	2,886	2,893	3,062	2,977	2,909	3,078	3,037	3,295	3,179	3,257	3,351	3,349	3,108	3,205
Stocks, all oils	575,279	582,579	588,229	592,120	590,469	583,507	583,970	579,259	575,954	570,028	563,034	555,263	555,263	564,997

[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.

RESERVES

The proved oil reserves of the United States were estimated at 17,348 million barrels as of January 1, 1939, 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 amount of crude oil that may be extracted by present known methods from fields completely developed or drilled or sufficiently explored to permit reasonably accurate calculations. The following table shows the previous estimates of reserves made by this committee, the figures for January 1, 1935, 1937, and 1938, being final and those for 1939 preliminary, subject to later revision.

Estimates of proved oil reserves in the United States, on January 1, 1935 and 1937–39, by States [1]

[Millions of barrels]

State	1935 [2]	1937 [2]	1938 [2]	1939 [3]
Eastern States:				
Illinois	37	28	59	243
Indiana	5	3	7	6
Kentucky	50	39	38	38
Michigan	64	63	46	43
New York	75	66	45	40
Ohio	40	32	30	26
Pennsylvania	340	307	218	200
West Virginia	40	32	28	25
	651	570	471	621
Central and Southern States:				
Arkansas	103	87	171	188
Kansas	390	590	607	613
Louisiana	513	657	1,049	1,040
New Mexico	451	581	739	703
Oklahoma	1,235	1,384	1,311	1,163
Texas	6,643	8,343	9,692	9,448
	9,335	11,642	13,569	13,155
Mountain States:				
Colorado	16	19	19	18
Montana	102	115	109	104
Wyoming	267	260	280	261
	385	394	408	383
Pacific Coast States: California	3,261	3,251	3,303	3,189
Total United States	13,632	15,857	17,751	17,348

[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.

LEGISLATION AND PRORATION

In 1938, as in 1936 and 1937, State and Federal regulation, including taxes, on petroleum maintained the "status quo." Most of the State legislation was routine in character, and no additions were made to the ranks of the prorating States or to the Interstate Oil Compact. The principal functions of the Federal Government in regulation of public lands continued to be those relating to the Connally Law. Several taxes of the Federal Government were not renewed.

The Bureau of Mines forecasts of demand by States were issued monthly throughout the year. As indicated in the table, actual production for the United States averaged about 60,000 barrels less than the estimates of demand. Crude-oil stocks were drawn on about 85,000 barrels daily, hence the actual demand for crude oil ran about 25,000 barrels daily, or less than 1 percent above the Bureau's estimates. The Bureau's record in estimating gasoline demand in 1938 was even better, the margin of error being less than one-half of 1 percent.

State allowables and Bureau of Mines estimates of market demand,[1] compared with actual production in the United States, in 1938

[Daily averages, in thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Texas:												
State allowable [2]	1,331	1,273	1,342	1,366	1,220	1,206	1,386	1,443	1,260	1,309	1,311	1,325
Bureau of Mines estimate	1,351	1,366	1,345	1,330	1,323	1,329	1,360	1,378	1,399	1,359	1,371	1,344
Actual production	1,318	1,273	1,339	1,351	1,216	1,212	1,365	1,412	1,261	1,282	1,295	1,307
Oklahoma:												
State allowable [3]	550	500	475	475	423	405	428	428	428	428	428	428
Bureau of Mines estimate	567	570	548	527	510	508	518	530	528	524	515	501
Actual production	562	535	526	505	464	431	450	471	469	454	441	446
California:												
State allowable [4]	678	694	695	699	620	620	620	615	615	615	615	615
Bureau of Mines estimate	678	694	695	699	668	650	642	649	638	619	617	590
Actual production	710	736	724	722	689	672	661	670	664	659	663	646
Kansas:												
State allowable [5]	186	182	183	184	160	168	171	168	163	161	162	162
Bureau of Mines estimate	179	176	177	173	169	172	172	169	168	163	164	159
Actual production	183	171	171	170	153	157	157	167	161	156	157	156
Louisiana:												
State allowable [6]	256	245	247	252	251	250	250	257	260	260	236	248
Bureau of Mines estimate	238	239	239	240	243	250	261	256	255	248	256	248
Actual production	253	258	259	257	257	261	264	260	265	272	256	255
New Mexico:												
State allowable [7]	105	101	101	106	97	91	102	107	106	105	106	98
Bureau of Mines estimate	103	105	105	106	104	108	113	112	112	109	111	100
Actual production	105	104	102	98	93	87	94	96	96	100	103	98
Arkansas:												
State allowable [8]	40	47	50	55	41	45	53	55	56	51	48	50
Bureau of Mines estimate	35	37	38	40	45	48	51	54	54	54	52	52
Actual production	42	48	50	53	41	42	54	55	57	52	49	50
Other States:												
Bureau of Mines estimate	256	251	245	247	256	268	281	290	290	291	305	312
Actual production	247	256	265	267	270	281	274	294	316	310	322	342
United States:												
Bureau of Mines estimate	3,407	3,438	3,392	3,362	3,318	3,333	3,398	3,438	3,444	3,367	3,391	3,306
Actual production	3,420	3,381	3,436	3,423	3,183	3,143	3,319	3,425	3,289	3,285	3,286	3,300

[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] Railroad Commission of Texas.
[3] 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.
[4] Central Committee of California Oil Producers.
[5] State Corporation Commission of Kansas.
[6] Department of Conservation, Louisiana. State allowable figures shown do not include production permitted under special orders of said Department.
[7] 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.
[8] Oil and Gas Commission.

EMPLOYMENT AND LABOR PRODUCTIVITY

The Bureau of Mines canvass of workers in the oil fields indicated an average employment of 121,371 for 1937, or 7 percent above the revised figure of 113,839 for 1936. The factors responsible for this gain were essentially the same as those underlying the material gain in number of workers in 1936, namely, higher prices and better profits, increased drilling, more wells connected to lines, and higher production. The totals above include the average number of part-time workers, totaling 12,903 in 1936 and 12,321 in 1937. Probably many of the new full-time employees in 1937 were recruited from the ranks of the part-time workers. Scattered returns for 1938 indicate a decline in employment, and the total number of workers for that year may not exceed the total of about 114,000 for 1936.

More oil-field workers were employed in 1937 than in 1936 in the majority of the States, only Colorado, Indiana, Montana, Ohio, and West Virginia showing declines. The largest relative gain was in Illinois, where recently discovered fields gave employment to about 500 new wage earners.

Employment at wells, crude petroleum produced, and average output per man in the United States, 1936–37, by States [1]

State	Average number of workers		Crude petroleum production (thousands of barrels)		Labor productivity (barrels per man-hour)	
	1936	1937	1936	1937	1936	1937
Arkansas	1,794	1,940	10,469	11,764	2.75	2.79
California	18,073	19,640	214,773	238,521	6.76	6.68
Colorado	[2] 126	110	1,650	1,605	6.25	7.20
Illinois	1,492	1,920	4,475	7,499	1.23	1.65
Indiana	244	230	822	844	1.78	1.91
Kansas	8,667	9,470	58,317	70,761	3.44	3.81
Kentucky	1,382	1,425	5,633	5,484	2.12	1.92
Louisiana	6,728	7,640	80,491	90,924	6.20	6.50
Michigan	1,150	1,705	11,928	16,628	5.38	4.67
Montana	598	590	5,868	5,805	5.07	4.94
New Mexico	1,155	1,190	27,223	38,854	13.49	16.07
New York	1,699	1,703	4,663	5,478	1.25	1.40
Ohio	2,442	2,350	3,847	3,559	.88	.81
Oklahoma	22,515	23,100	206,555	228,839	4.68	4.91
Pennsylvania	6,687	7,420	17,070	19,189	1.31	1.34
Texas	33,902	35,600	427,411	510,318	6.59	7.24
West Virginia	3,315	3,220	3,847	3,845	.66	.68
Wyoming	1,858	2,100	14,582	19,166	3.53	3.92
Other States [3]	12	18	63	77	2.86	2.41
Total United States	[2] 113,839	121,371	1,099,687	1,279,160	5.04	5.33

[1] Figures for 1938 not yet available.
[2] Revised figures.
[3] Missouri, Tennessee, and Utah.

The average number of hours per week increased from 39.5 to 40.5 for the full-time workers, but the total hours of the part-time workers declined from an average of 835 in 1936 to 811 in 1937. Total man-hours increased from 217,988,000 in 1936 to 239,834,000 in 1937, a gain of 10 percent. Dividing total production by total man-hours gives labor-productivity averages of 5.04 barrels per man-hour in 1936 and 5.33 barrels in 1937. The gain is indicative of the extent to which technologic advances are outstripping increasing physical difficulties.

CRUDE PETROLEUM

SUPPLY AND DEMAND

Although production declined 5 percent in 1938 from 1937 the total demand for crude oil decreased less than 20,000,000 barrels, or about 1.5 percent. As imports of crude oil were about the same in the 2 years, the statistical explanation lies in the trend of crude-oil stocks, which in 1938 were reduced about 29,000,000 barrels compared with a gain of about 18,000,000 barrels in 1937. Actually, the decline in real demand for crude oil in 1938 was less than is indicated above (1.5 percent), as the increase in refined inventories in 1938, while substantial, was less than in 1937.

The demand for heavy crude oil as fuel without refining declined materially, following the general stagnation of the fuel-oil market, but this loss of business was more than offset by a 10,000,000-barrel increase in exports.

Supply of and demand for crude petroleum, 1934–38

[Thousands of barrels]

	1934	1935	1936	1937	1938 [1]
Production	908, 065	996, 596	1, 099, 687	1, 279, 160	1, 213, 254
Imports [2]	35, 558	32, 239	32, 327	27, 484	26, 412
Changes in stocks east of California and in stocks of California light crude	−16, 969	−22, 399	−26, 276	+18, 247	[3] −28, 776
Total demand	960, 592	1, 051, 234	1, 158, 290	1, 288, 397	1, 268, 442
Runs to stills:					
Domestic	860, 776	933, 659	1, 034, 637	1, 157, 444	1, 138, 828
Foreign	34, 860	32, 131	33, 933	25, 996	26, 187
Exports [4]	41, 127	51, 430	50, 313	67, 234	77, 273
Transfers to fuel-oil stocks in California	8, 382	13, 067	15, 732	17, 423	10, 660
Consumed as fuel on producing properties [5]	1, 523	1, 338	1, 664	1, 308	15, 494
Consumed as fuel in operation of pipe lines [5]	1, 835	1, 931	2, 138	2, 178	
Other fuel and losses	12, 089	17, 678	19, 873	16, 814	
Total demand	960, 592	1, 051, 234	1, 158, 290	1, 288, 397	1, 268, 442

[1] Subject to revision.
[2] As reported to the Bureau of Mines.
[3] Includes California heavy crude.
[4] Includes shipments to Alaska, Hawaii, and Puerto Rico.
[5] East of California.

PRODUCTION

As shown in figure 2, the general trend of crude-oil production in 1938 was downward, as the fact gradually dawned that demand would be less than in 1937 and as proration restrictions were accordingly tightened. More specifically, the fluctuations in the trend correlate closely with the Saturday and Sunday shut-downs in Texas. The Sunday shut-downs, instituted January 23, 1938, were instrumental principally in preventing production from rising much above the 3,400,000-barrel mark; but the Saturday shut-downs, first added on May 14 and in effect over most of the remainder of the year, reduced production to below 3,300,000 barrels. Most of the other States with regulatory bodies assisted in the curtailment program, the decline in Oklahoma more than offsetting the gain in Illinois.

Texas continued to produce more than California and Oklahoma combined, but its proportion of the national total declined from 39.9 percent in 1937 to 39.2 in 1938. California's share increased materially, but Oklahoma's percentage in 1938 (14.4) was the lowest since 1906, when the State was coming into prominence. The most notable

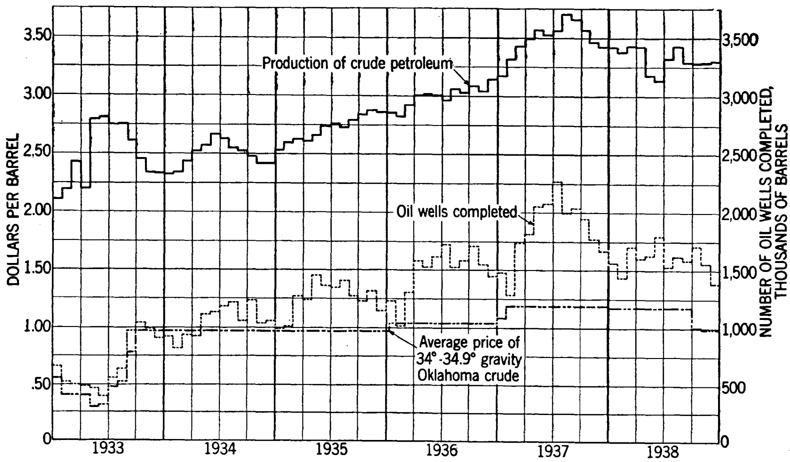

FIGURE 2.—Daily average production of crude petroleum, total number of oil wells completed, and average price per barrel of a selected grade of Oklahoma crude petroleum, 1933–38, by months.

increase of any State in 1938 was made by Illinois, whose percentage rose from 0.6 in 1937 to 2.0 in 1938.

The relative rank of the producing States is shown graphically in figure 3.

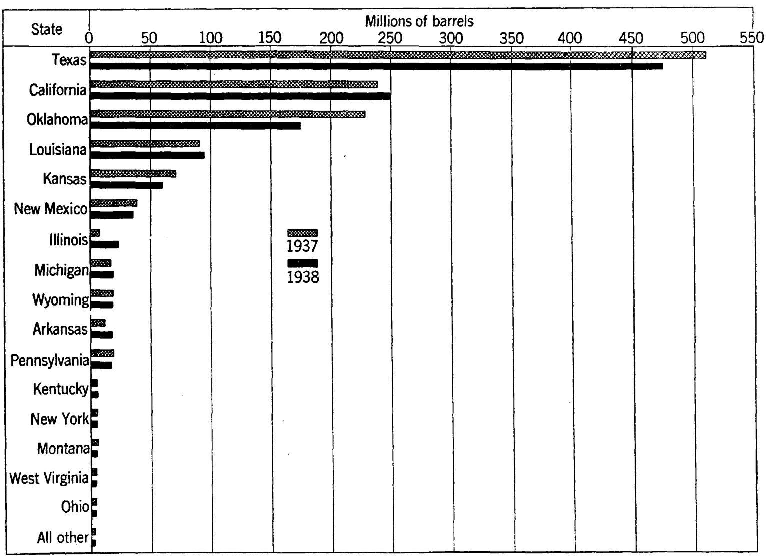

FIGURE 3.—Production of crude petroleum, 1937–38, by States.

Although output in the majority of the producing districts increased in 1938, these gains were far outweighed by the decline in the Mid-Continent. The district with the most notable series of gains is the Gulf Coast, which has increased steadily in output since 1932.

Production of crude petroleum in the United States in 1938, by districts, States, and months

[Thousands of barrels]

District and State	1938 [1]													1937 (total)
	January	February	March	April	May	June	July	August	September	October	November	December	Total	
DISTRICT														
Pennsylvania grade	2,394	2,267	2,555	2,344	2,386	2,276	2,184	2,314	2,189	2,198	2,056	2,153	27,316	29,862
Other Appalachian (including Kentucky)	534	532	601	561	593	623	636	696	681	657	689	654	7,407	7,102
Lima-Northeastern Indiana-Michigan	1,599	1,465	1,660	1,701	1,760	1,691	1,679	1,526	1,679	1,724	1,667	1,643	19,794	17,272
Illinois-Southwestern Indiana	1,194	1,178	1,403	1,461	1,518	1,546	1,729	2,154	2,642	2,854	3,150	4,069	24,898	8,325
North Louisiana and Arkansas	3,713	3,591	4,022	3,987	3,742	3,673	4,181	4,256	4,091	4,016	3,647	3,795	46,714	40,647
West Texas and Southeastern New Mexico	9,049	8,048	9,356	8,798	8,561	8,203	9,418	9,674	8,755	9,373	9,302	9,524	108,061	114,209
East Texas	14,426	12,146	13,738	13,244	11,900	11,376	13,530	14,062	11,669	12,238	11,678	12,136	152,143	170,673
Oklahoma, Kansas, North Texas, etc	34,339	29,913	33,405	31,916	30,167	28,289	30,805	32,094	29,749	30,046	28,993	30,292	370,008	448,840
Gulf Coast	14,761	13,141	15,296	15,006	14,579	14,105	15,964	16,226	14,997	16,091	15,425	15,887	181,478	176,743
Rocky Mountain	1,990	1,773	2,047	2,037	2,121	2,325	2,278	2,393	2,287	2,210	2,126	2,099	25,686	26,966
California	22,008	20,608	22,441	21,647	21,347	20,170	20,494	20,770	19,922	20,423	19,884	20,035	249,749	238,521
Total United States	106,007	94,662	106,524	102,702	98,674	94,277	102,898	106,165	98,661	101,830	98,567	102,287	1,213,254	1,279,160
STATE														
Arkansas	1,286	1,335	1,562	1,576	1,277	1,272	1,680	1,718	1,721	1,624	1,470	1,556	18,077	11,764
California	22,008	20,608	22,441	21,647	21,347	20,170	20,494	20,770	19,922	20,423	19,884	20,035	249,749	238,521
Colorado	114	104	116	132	142	135	109	128	93	125	104	110	1,412	1,605
Illinois	1,128	1,108	1,330	1,388	1,440	1,462	1,642	2,062	2,553	2,768	3,067	3,981	23,929	7,499
Indiana	66	70	73	73	78	84	87	92	89	86	83	88	969	844
Kansas	5,680	4,786	5,292	5,104	4,758	4,702	4,869	5,190	4,821	4,835	4,724	4,826	59,587	70,761
Kentucky	411	406	457	432	459	487	506	553	547	526	514	523	5,821	5,484
Louisiana	7,843	7,224	8,014	7,718	7,954	7,816	8,195	8,065	7,954	8,429	7,689	7,911	94,812	90,924
Michigan	1,564	1,429	1,610	1,655	1,711	1,639	1,632	1,465	1,624	1,665	1,622	1,595	19,211	16,628
Montana	375	369	408	410	439	441	407	416	418	412	411	401	4,907	5,805
New Mexico	3,256	2,905	3,159	2,925	2,889	2,606	2,927	2,974	2,883	3,093	3,103	3,039	35,759	38,854
New York	444	409	455	429	447	418	404	429	406	404	391	409	5,045	5,478
Ohio	248	258	301	274	281	286	266	301	277	278	257	271	3,298	3,559
Oklahoma	17,409	14,986	16,297	15,137	14,388	12,919	13,941	14,616	14,079	14,066	13,228	13,816	174,882	228,839
Pennsylvania	1,566	1,466	1,653	1,497	1,517	1,432	1,385	1,460	1,377	1,383	1,318	1,372	17,426	19,189
Texas	40,847	35,639	41,514	40,515	37,710	36,360	42,315	43,781	37,828	39,738	38,857	40,510	475,614	510,318
West Virginia	290	294	337	317	322	326	304	325	315	320	257	277	3,684	3,845
Wyoming	1,465	1,261	1,499	1,468	1,510	1,717	1,730	1,814	1,748	1,649	1,582	1,561	19,004	19,166
Other States [2]	7	5	6	5	5	5	5	6	6	6	6	6	68	77
Total United States: 1938	106,007	94,662	106,524	102,702	98,674	94,277	102,898	106,165	98,661	101,830	98,567	102,287	1,213,254	
1937	98,537	93,061	106,833	105,127	110,959	106,068	110,783	115,413	110,052	111,196	104,302	106,829		1,279,160
Daily average 1938	3,420	3,381	3,436	3,423	3,183	3,143	3,319	3,425	3,289	3,285	3,286	3,300	3,324	3,505

[1] Subject to revision.

[2] Missouri, Tennessee, and Utah.

Petroleum produced in the United States, 1934–38, and 1859–1938 total, by States [1]

[Thousands of barrels of 42 gallons]

	1934	1935	1936	1937	1938 [2]	Total 1859–1938 [2]
Arkansas	11,182	11,008	10,469	11,764	18,077	459,301
California	174,305	207,832	214,773	238,521	249,749	5,121,843
Colorado	1,139	1,560	1,650	1,605	1,412	36,866
Illinois	4,479	4,322	4,475	7,499	23,929	456,967
Indiana	838	777	822	844	969	124,395
Kansas	46,482	54,843	58,317	70,761	59,587	[3] 993,614
Kentucky	4,860	5,258	5,633	5,484	5,821	[4] 156,352
Louisiana	32,869	50,330	80,491	90,924	94,812	862,363
Michigan	10,603	15,776	11,928	16,628	19,211	[5] 102,357
Montana	3,603	4,603	5,868	5,805	4,907	70,765
New Mexico	16,864	20,483	27,223	38,854	35,759	[6] 197,993
New York	3,804	4,236	4,663	5,478	5,045	[7] 108,680
Ohio	4,234	4,082	3,847	3,559	3,298	582,062
Oklahoma	180,107	185,288	206,555	228,839	174,882	[3] 4,489,934
Pennsylvania	14,478	15,810	17,070	19,189	17,426	[7] 962,333
Texas	381,516	392,666	427,411	510,318	475,614	5,602,834
West Virginia	4,095	3,902	3,847	3,845	3,684	403,746
Wyoming	12,556	13,755	14,582	19,166	19,004	453,795
Other States [8]	51	65	63	77	68	941
Total United States	908,065	996,596	1,099,687	1,279,160	1,213,254	21,187,141
Value at wells:						
Total (thousands of dollars)	904,825	961,440	1,199,820	1,513,340	1,390,000	25,480,409
Average per barrel	$1.00	$0.96	$1.09	$1.18	$1.15	$1.20

[1] For detailed figures by States, 1859–1935, see Minerals Yearbook, 1937, p. 1008.
[2] Subject to revision.
[3] Oklahoma included with Kansas in 1905 and 1906.
[4] Includes Tennessee, 1883–1907.
[5] Figures represent 1925–38 production only; earlier years included under "Other States."
[6] Figures represent 1924–38 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; Missouri, 1889–1911, 1913–16, 1919–23, 1932–38; New Mexico, 1913, 1919–23; Tennessee, 1916–38; Utah, 1907–11, 1920, 1924–38.

Percentage of total crude petroleum produced in the United States, 1930–38, by principal States

State	1930	1931	1932	1933	1934	1935	1936	1937	1938 [1]
Texas	32.4	39.1	39.8	44.5	42.0	39.4	38.9	39.9	39.2
California	25.3	22.2	22.7	19.0	19.2	20.9	19.5	18.6	20.6
Oklahoma	24.1	21.2	19.5	20.1	19.9	18.6	18.8	17.9	14.4
Total, 3 States	81.8	82.5	82.0	83.6	81.1	78.9	77.2	76.4	74.2
Louisiana	2.6	2.6	2.8	2.8	3.6	5.0	7.3	7.1	7.8
Kansas	4.7	4.4	4.4	4.6	5.1	5.5	5.3	5.5	4.9
New Mexico	1.1	1.8	1.6	1.6	1.9	2.1	2.5	3.1	3.0
Illinois	.6	.6	.6	.5	.5	.4	.4	.6	2.0
Michigan	.4	.4	.9	.9	1.2	1.5	1.1	1.3	1.6
Arkansas	2.2	1.7	1.5	1.3	1.1	1.1	.9	.9	1.5
Pennsylvania	1.4	1.4	1.6	1.4	1.6	1.6	1.6	1.5	1.4
All other	5.2	4.6	4.6	3.3	3.9	3.9	3.7	3.6	3.6
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.

Production of crude petroleum in leading fields in the United States, 1937–38, with total production since discovery [1]

[Thousands of barrels]

Field	State	1937	1938	Total since discovery
East Texas [2]	Texas	170,700	[3] 152,100	1,285,000
Midway-Sunset	California	26,500	22,900	858,000
Seminole	Oklahoma	30,500	26,300	786,000
Long Beach	California	21,900	20,600	621,000
Oklahoma City	Oklahoma	54,800	[3] 40,800	450,000
Santa Fe Springs	California	15,800	12,600	447,000
Bradford-Allegany	Pennsylvania-New York	20,400	18,500	403,000
Smackover	Arkansas	6,900	6,500	373,000
Coalinga	California	5,800	3,900	355,000
Cushing-Shamrock	Oklahoma	3,900	3,800	336,000
Augusta-Eldorado	Kansas	6,000	5,700	289,000
Salt Creek [2]	Wyoming	5,900	[3] 5,700	283,000
Huntington Beach	California	13,300	11,900	271,000
Yates [2]	Texas	11,400	7,400	247,000
Kettleman Hills	California	29,100	25,600	202,000
Crane-Upton	Texas	10,800	13,800	155,000
Caddo [2]	Louisiana	2,400	[3] 2,700	149,000
Pampa	Texas	13,400	10,900	147,000
Van [2]	do	11,300	[3] 5,600	115,000
Conroe	do	15,200	11,600	98,000
Hobbs	New Mexico	7,300	5,000	93,000
Rodessa	Arkansas-Louisiana-Texas	31,800	27,500	83,000
Fitts	Oklahoma	31,000	16,700	75,000
Wilmington	California	14,200	34,200	48,000

[1] Oil and Gas Journal, except as noted.
[2] Bureau of Mines.
[3] Subject to revision.

The upward trend in the production of Pennsylvania Grade oil was interrupted in 1938, when the output in all four of the States yielding this type of oil declined. The total production in 1938 was 27,316,000 barrels compared with 29,862,000 in 1937. The decline, most of which was in the Bradford field, was caused by the price reductions of 1938, aggregating 27 percent, or 70 cents per barrel.

Pennsylvania grade crude oil produced, 1929–38, by States

[Thousands of barrels]

State	1929 [1]	1930	1931	1932	1933	1934	1935	1936	1937	1938 [2]
New York	3,377	3,647	3,363	3,508	3,181	3,804	4,236	4,663	5,478	5,045
Pennsylvania	11,820	12,786	11,876	12,396	12,607	14,462	15,794	17,053	19,173	17,408
West Virginia	5,574	5,068	4,470	3,875	3,815	4,095	3,901	3,846	3,844	3,684
Central and eastern Ohio	2,654	2,742	2,184	1,741	1,594	1,597	1,547	1,510	1,367	1,179
	23,425	24,243	21,893	21,520	21,197	23,958	25,478	27,072	29,862	27,316

[1] Pennsylvania Grade Crude Oil Association. [2] Subject to revision.

Arkansas.—Considering the steady decline in production in Arkansas from 1925 to 1937, the gain from 11,764,000 barrels produced in 1937 to just over 18,000,000 barrels in 1938 was sensational. This advance was due primarily to the active development of the Schuler field, although Rodessa also helped out. About 200 oil wells were completed in 1938, or approximately double the 1937 total.

The new discoveries of 1938 were limited almost entirely to Smackover lime pools in Columbia County. Of these the Magnolia field appeared most important.

Production of crude petroleum in Arkansas, 1933–37, by districts [1]

[Thousands of barrels]

Year	Buckner	Champagnolle	El Dorado	Irma	Lisbon	Miller	Rodessa	Schuler	Smackover	Stephens	Urbana	Total
1933	-------	488	1,231	264	95	100	-------	-------	8,882	127	499	11,686
1934	-------	486	991	300	89	364	-------	-------	7,916	210	826	11,182
1935	-------	872	862	391	66	444	-------	-------	7,368	212	793	11,008
1936	-------	900	811	383	114	270	-------	-------	7,126	214	651	10,469
1937	21	522	747	433	80	154	1,252	1,153	6,751	205	446	11,764

[1] Figures by districts for 1938 not yet available.

California.—Production increased in California in 1938 for the fifth successive year, although the gain was not as large as that of 1937 over 1936. Although exports held up well, the total being slightly higher than in 1937, the domestic demand for all oils was materially lower. The increase in production, therefore, largely represented the degree to which curtailment efforts were outweighed by the superior forces of potential capacity. The voluntary proration program was heroically projected at various times, but the goal of 600,000 barrels of daily production was not in sight until very late in the year.

Measured in terms of number of wells, drilling declined materially in 1938 from 1937. However, from the standpoint of total footage there was little if any decrease, and in initial production there was a large gain. Thus the average initial per well per day for the oil wells completed in 1938 was about 930 barrels compared with about 540 barrels in 1937.

Production of crude petroleum in California, 1934–38, by districts

[Thousands of barrels]

District	1934 [1]	1935 [2]	1936 [2]	1937 [2]	1938 [2]
San Joaquin Valley:					
Belridge	2,916	3,629	4,648	6,332	5,312
Canal	-------	-------	-------	31	849
Coalinga	6,525	7,249	6,067	5,759	3,898
Edison	(3)	979	2,023	1,577	1,102
Elk Hills	3,338	3,216	3,194	3,787	3,887
Fruitvale	1,313	1,848	2,903	3,246	3,078
Greeley	-------	-------	-------	527	1,164
Kern River	3,624	4,518	5,163	5,639	4,590
Kettleman Hills	21,391	27,607	29,287	29,132	25,609
Lost Hills	1,442	1,762	1,347	1,414	1,297
McKittrick	1,076	1,394	777	1,308	1,289
Midway-Sunset	19,651	20,240	21,482	26,485	22,875
Mountain View	2,581	9,229	9,713	6,843	4,033
Mount Poso	3,348	5,540	6,747	6,677	6,235
Rio Bravo	-------	-------	-------	128	1,945
Round Mountain	1,151	2,327	3,955	4,835	5,474
Ten Section	-------	-------	-------	932	2,473
Other San Joquin Valley	1,005	153	321	120	285
Total San Joaquin Valley	69,361	89,691	97,627	104,772	95,395

See footnotes at end of table.

Production of crude petroleum in California, 1934–38, by districts—Continued

District	1934 [1]	1935 [2]	1936 [2]	1937 [2]	1938 [2]
Coastal district:					
Capitan	194	522	571	918	1,067
Elwood	4,100	4,560	4,479	3,203	2,247
Rincon	538	670	754	1,058	1,395
San Miguelito	268	296	580	1,147	1,044
Santa Maria	1,749	1,531	1,668	3,893	6,128
Ventura Avenue	9,865	10,979	12,610	12,685	12,926
Other Coastal	2,008	2,653	2,239	2,113	2,089
Total Coastal	18,722	21,211	22,901	25,017	26,896
Los Angeles Basin:					
Brea Olinda	3,720	3,612	2,961	2,659	2,125
Coyote	4,112	4,540	3,944	4,269	4,354
Dominguez	6,650	7,916	9,712	9,839	9,756
El Segundo			149	3,632	3,872
Huntington Beach	15,006	15,133	13,247	13,255	11,917
Inglewood	3,364	4,477	4,547	5,530	5,337
Long Beach	22,788	26,563	24,994	21,872	20,599
Montebello	1,963	2,287	3,205	3,167	4,147
Playa del Rey	3,116	5,696	4,644	3,181	2,305
Richfield	2,856	2,804	2,443	3,158	3,333
Rosecrans	1,032	993	804	1,259	3,732
Santa Fe Springs	14,662	16,159	16,460	15,745	12,630
Seal Beach	2,715	3,381	3,463	3,416	3,198
Torrance	2,498	2,498	2,860	2,833	5,203
Wilmington				14,186	34,168
Other Los Angeles Basin	1,740	871	812	731	782
Total Los Angeles Basin	86,222	96,930	94,245	108,732	127,458
Total California	174,305	207,832	214,773	238,521	249,749

[1] Central Committee of California Oil Producers.
[2] American Petroleum Institute.
[3] Included under "Other San Joaquin Valley."

Most of the fields declined in output in 1938, and only Wilmington, Santa Maria, Torrance, and Rosecrans increased appreciably. The Wilmington field became the leading field of the State by virtue of a gain from 14,186,000 barrels produced in 1937 to 34,168,000 barrels in 1938.

Exploration was extensive and generally successful in California in 1938, and a sizable net addition was made to reserves. Most of the new discoveries were in Kern County; the average depth of the new fields was about 8,000 feet. In point of reserves probably the Southeast Coalinga field was the most important discovery in California in 1937, but in general interest the Wasco discovery, Kern County, ranked first, because the discovery well set a new depth record of 15,004 feet, although the production was obtained from a zone at about 13,000 feet. Drilling in the Canal, Greeley, Montebello, Rio Bravo, Torrance, and Wilmington fields uncovered substantial new reserves, chiefly in new deep sands.

Colorado.—The downward turn in production in Colorado, which began in 1937, was accentuated in 1938 when only about 1,400,000 barrels were produced compared with 1,605,000 barrels in 1937. Seven oil wells were brought in in 1938 compared with only two in 1937, yet the total initial increased but slightly.

The Nelson Creek discovery of late 1937 was followed up with some success in 1938. The oil-producing areas within the Hiawatha gas field of Moffat County were enlarged during the year.

Production of crude petroleum in Colorado, 1933–37, by districts [1]

[Thousands of barrels]

Year	Florence [2]	Fort Collins [3]	Greasewood	Iles	Moffat	Price	Rangely	Tow Creek	Total
1933	91	226	56	213	212		[4] 33	88	919
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

[1] Figures by districts for 1938 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 was trebled in 1938 over 1937, the output rising from 7,499,000 barrels to about 24,000,000 barrels. The 1938 production did not constitute a new record, several years around 1910 having larger totals. However, it is virtually a certainty that 1939 will bring a new peak. Production in 1938 rose steadily throughout the year, starting at about 35,000 barrels daily and reaching about 135,000 barrels by December 31. Drilling increased rapidly up to October, after which it tapered off with the advent of cold weather. At present the State ranks second only to Texas in completions.

Although the fields of Clay and Richland Counties in east central Illinois, the center of development in 1937, probably led in production in 1938, these fields declined rapidly as the center of interest shifted westward to the new discoveries in the Centralia district. These were the Centralia townsite pool, which had a rapid rise and decline in the middle of the year; Salem or Lake Centralia, the production of which rose to 50,000 daily by the end of the year; and Louden, in Fayette County, which was more conservatively developed than the others. In all fields 1,806 oil wells were completed compared with 272 in 1937 and 27 in 1936.

Another discovery of note was the finding of oil in the Devonian of the old Sandoval field. The fields of Clay and Richland Counties produce from the McClosky lime; but in the Centralia district the Benoist sand, several hundred feet above, was of primary importance until more and more operators began to explore the McClosky late in the year.

Indiana.—Although the number of oil wells completed in Indiana in 1938 declined slightly, the total initial trebled and the production rose from 844,000 barrels in 1937 to 969,000 barrels in 1938. The interest in Illinois developments spread to Indiana, and the resulting discoveries appeared more important than in many years.

Kansas.—The loss of markets and decline in price of crude dampened the enthusiasm of drillers in Kansas in 1938, and the number of oil wells completed—1,108—was about 40 percent lower than in 1937 and even below the level of 1936. However, wildcatters were unusually successful, and nearly 60 new pools were opened. These were scattered over more than a score of counties, Russell, Barton, and Stafford being prominent. Production crept farther west, Finney, Ford, and Graham Counties being added to the producing column in

1938. Other interesting field developments were the increase in water-flood projects in the old southeastern fields and the prospecting in that part of the Forest City Basin that extends into northeast Kansas.

The production for the year was 59,587,000 barrels—16 percent less than the record of 70,761,000 barrels established in 1937. Production decreased in the majority of the fields. Notable exceptions were, however, Weathered, Cowley County; Gorham, Russell County; and Geneseo, Rose County.

Production of crude petroleum in Kansas, 1934–38, by counties [1]

[Thousands of barrels]

County	1934	1935	1936	1937	1938
Barton	446	738	1,195	3,519	3,490
Butler:					
Eldorado district	1,974	3,920	3,508	3,340	3,023
Other districts	5,392	2,792	2,656	2,649	2,668
Cowley	1,681	1,154	1,804	1,973	2,318
Ellis	167	167	758	2,629	3,116
Ellsworth	1,161	2,596	3,014	2,121	1,248
Greenwood-Woodson	4,378	4,089	4,001	4,007	3,834
Harvey	3,426	2,916	1,592	1,559	1,081
McPherson:					
Graber district	41	191	442	1,233	1,082
Ritz Canton district	4,644	2,974	2,346	1,872	1,650
Voshell district	2,413	1,670	1,104	931	765
Other districts	2,799	750	572	415	343
Reno	2,333	7,584	5,985	6,812	4,287
Rice	4,241	8,069	11,427	15,487	10,629
Russell	2,548	4,146	7,074	11,379	9,446
Sedgwick	2,765	2,973	2,002	1,545	1,418
Sumner	1,138	2,077	3,231	2,342	1,698
Other counties	4,207	4,558	4,373	5,345	6,038
	45,754	53,364	57,084	69,158	58,134

[1] Oil and Gas Journal.

Kentucky.—Despite considerable buyer proration in 1938, production increased to 5,821,000 barrels from 5,484,000 in 1937. Drilling declined in the western fields in 1938; nevertheless, the initial discovered was four times as large as in 1937. Two new McClosky lime pools, both in Henderson County, were discovered in 1938. Drilling in the eastern part of the State increased in 1938, but a high percentage of the completions were gas wells, and the 150 oil wells brought in averaged only 15 barrels initial.

Louisiana.—Production in Louisiana rose to a new peak in 1938, when 94,812,000 barrels were produced compared with 90,924,000 barrels in 1937. The northern fields about held their own, a 5,000,000-barrel decline at Rodessa being balanced by a comparable gain elsewhere, hence the increase was in the coastal district. Drilling increased slightly, as a loss in the northern fields was outweighed by a gain in the coastal or salt-dome fields.

Only one new field—Cross Lake near Shreveport—was discovered in the northern district in 1938. Deep sand discoveries continued important at Cotton Valley, this field and Lisbon supplying most of the gain to compensate Rodessa's decline.

In the coastal district exploration continued apace, and about 20 new fields were discovered in 1938. This record surpassed even that of the Texas Gulf Coast. Drilling was carried deeper and deeper, the deepest producing well in the world at the close of the year being one in the new Dulac field at about 13,260 feet. Extensions, flank production, and deeper sands too numerous to mention individually were found. The "Conroe trend" play was given a substantial boost by the discovery of flush Cockfield production at Bancroft, Beauregard Parish.

Production of crude petroleum in Louisiana, 1933–37, by districts [1]

[Thousands of barrels]

District	1933	1934	1935	1936	1937
Gulf Coast:					
Black Bayou	292	422	564	1,087	1,313
Bosco		1,036	6,355	4,661	3,020
Caillou Island	362	1,748	3,288	5,504	6,402
Cameron Meadows	(2)	419	1,046	1,848	1,490
Choctaw	100	324	276	346	440
Darrow		(2)	263	526	717
Dog Lake			(2)	227	674
English Bayou			713	2,511	2,871
Gibson					453
Gillis		(2)	1,492	3,262	2,217
Gueydan	165	110	82	58	99
Hackberry	1,938	1,911	2,580	3,125	4,592
Iowa	3,396	5,300	7,363	6,626	6,383
Jeanerette			(2)	985	2,277
Jennings	400	444	686	754	2,996
Lafitte			635	2,709	4,136
Lake Barre	3,021	1,894	2,792	2,532	1,368
Leeville	359	4,487	[3] 5,388	4,679	2,629
Lockport	938	714	655	474	528
New Iberia			(3)	2,191	6,231
Port Barre	956	937	1,250	797	600
Roanoke		241	1,631	2,282	1,890
Sulphur	910	1,256	944	1,793	1,414
Sweet Lake	335	385	403	350	294
Tepetate			(2)	1,456	2,158
Valentine					968
Vinton	1,302	1,168	906	650	470
White Castle	192	191	196	336	490
Other Gulf Coast	640	807	1,268	1,805	2,921
Total Gulf Coast	15,306	23,794	40,776	53,574	62,041
Northern:					
Caddo	2,248	2,200	2,630	2,554	2,353
Cotton Valley	307	290	233	207	1,151
Haynesville	1,402	1,379	1,266	1,216	1,143
Homer	991	980	977	950	932
Lisbon					2,490
Rodessa			1,364	19,220	18,050
Urania	883	1,077	1,062	1,060	1,085
Zwolle	3,007	1,675	626	393	266
Other Northern	1,024	1,474	1,396	1,317	1,413
Total Northern	9,862	9,075	9,554	26,917	28,883
Total Louisiana	25,168	32,869	50,330	80,491	90,924

[1] Figures by districts for 1938 not yet available.
[2] Included under "Other Gulf Coast."
[3] Leeville includes New Iberia.

Michigan.—Production in Michigan reached a new peak of 19,211,000 barrels in 1938 compared with the previous record of 16,628,000 barrels in 1937. The several declines in Michigan crude-oil prices, totaling 35 cents or more per barrel, dimmed the enthusiasm for development work; nevertheless, the number of oil wells brought in—566—was only 20 less than in 1937.

About a half dozen new fields were uncovered in Michigan in 1938, most of them being in the southwest corner of the State in nearly virgin territory. Of the new fields, Bloomingdale, Van Buren County, was the most active, but Freeman-Redding, Clare County, yielded the largest wells and appeared to have the most promising future.

Production of crude petroleum in Michigan, 1933–37, by districts [1]

[Thousands of barrels]

Year	Buckeye	Clayton	Crystal	Mount Pleasant	Muskegon	Porter	Sherman	Vernon	West Branch	Yost-Jasper	Other districts	Total
1933	-------	-------	-------	3,129	276	3,354	-------	539	--------	219	425	7,942
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

[1] Figures by districts for 1938 not yet available. Data from Department of Conservation, Michigan.

Mississippi.—The potentialities of Mississippi as an oil producer are still favorably considered in some quarters, but developments of 1938 did little to enhance them. There was no commercial production reported in 1938, and drilling yielded but 6 gas wells and 19 dry holes.

Montana.—Production in Montana declined materially in 1938 (from 5,805,000 barrels in 1937 to 4,907,000 in 1938) as exports of crude to Canada decreased from 1,950,000 barrels in 1937 to 356,000 in 1938. Drilling again declined severely, and only about half as many oil wells were completed in 1938 as in 1937. The only new oil discovery was a field about 5 miles north of the Cut Bank field.

Production of crude petroleum in Montana, 1933–37, by districts [1]

[Thousands of barrels]

Year	Border	Cat Creek	Cut Bank	Dry Creek	Elk Basin	Kevin-Sunburst	Lake Basin	Pondera	Other districts	Total
1933	51	266	238	125	3	1,237	18	308	27	2,273
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

[1] Figures by districts for 1938 not yet available. [2] Included under "Other districts."

New Mexico.—Owing primarily to relatively greater curtailment, the output of New Mexico declined from the 1937 peak of 38,854,000 barrels to 35,759,000 in 1938. The number of oil wells brought in dropped 14 percent from 1937, but the total initial of 1938 was hardly a third of what it was in the preceding year. The Monument field succeeded Eunice as the leading producer. The Vacuum field led in development work in 1938. Extensions to old fields were numerous, but new fields discovered were limited to one oil field, West Eunice, and one gas field that promised to develop into an oil field.

Production of crude petroleum in New Mexico, 1933–37, by districts [1]

[Thousands of barrels]

Year	Artesia	Hobbs	Hogback	Lea [2]	Rattlesnake [3]	Total
1933	596	11,543	77	1,609	291	14,116
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

[1] Figures by districts for 1938 not yet available.
[2] Includes Cooper, Eunice, Jal, Monument, and other pools in Lea County.
[3] Includes Aztec and Table Mesa in 1933–35; Aztec, Bloomfield, Red Mountain, and Table Mesa in 1936; Aztec, Bloomfield, Hospah, and Table Mesa in 1937.

New York.—Field activity in New York in 1938 was depressed owing to the low prices; drilling declined severely and production decreased from 5,478,000 barrels in 1937 to 5,045,000 in 1938.

Ohio.—Drilling continued to decline in Ohio, and production still trended downward. The output in 1938 was 3,298,000 barrels, including 582,000 barrels from the Lima district, compared with 3,559,000 barrels in 1937.

Oklahoma.—Generally lower demand and a loss of markets to Illinois and possibly other States were the underlying factors in reducing production in Oklahoma from 228,839,000 barrels in 1937 to 174,882,000 in 1938.

The output of all the major fields fell in 1938, a decrease of about 20,500,000 barrels for the Oklahoma City field being largest and of about 14,000,000 barrels at Fitts being second. Many of the more prominent Wilcox sand areas declined 50 percent or more between 1937 and 1938. Much of the field work in 1938 was conducted in the greater Seminole district, hence production decline was comparatively small, from 49,772,000 barrels in 1937 to 42,182,000 in 1938.

Production of crude petroleum in Oklahoma, 1934–38, by districts [1]

[Thousands of barrels]

District	1934	1935	1936	1937	1938
Allen	3,065	2,897	3,076	2,511	2,475
Billings	37	77	204	2,349	2,108
Bristow	3,000	3,329	3,186	2,790	2,389
Burbank	3,406	3,102	2,827	2,871	2,814
Cleveland County			543	3,896	1,778
Crescent	1,237	2,003	2,301	3,851	1,687
Cushing-Shamrock	5,044	4,738	4,129	3,908	3,848
Dora				205	1,732
Edmond	92	1,478	4,370	5,884	2,030
Fish	1,381	3,422	3,114	2,077	1,224
Fitts	329	6,901	19,908	30,977	16,655
Healdton	3,386	3,397	3,436	3,654	3,401
Keokuk-South Keokuk	388	852	2,113	2,979	1,713
Lucien	2,903	3,744	4,542	5,047	3,524
Nowata County	2,258	2,414	3,179	3,450	4,390
Oklahoma City	60,833	53,386	51,232	54,776	38,796
Okmulgee County	2,030	1,796	1,692	1,752	1,753
Olympic			2,711	4,315	1,889
Osage (outside Burbank-South Burbank)	9,187	9,113	8,293	7,626	6,438
Seminole field:					
Bowlegs	3,761	3,845	4,335	4,178	3,200
Carr City	2,039	2,003	2,216	1,973	1,294
Earlsboro	7,680	7,414	6,601	5,596	3,751
Little River	5,371	5,587	5,068	4,222	3,040
St. Louis-Pearson	8,084	8,365	8,543	7,528	7,766
Seminole City	3,779	4,062	3,810	3,428	2,842
Other Seminole districts	5,388	3,347	4,150	3,574	4,448
Total Seminole field	36,102	34,623	34,723	30,499	26,341
Sholem-Alechem-Tatums	3,993	3,160	2,561	3,129	1,691
South Burbank	2,279	4,217	5,390	5,579	3,938
Tulsa	1,465	1,432	1,308	1,721	1,513
Other districts	36,237	36,516	36,043	37,261	35,180
Total Oklahoma	178,652	182,597	200,881	223,107	169,307

[1] Oil and Gas Journal.

Hardly half as many oil wells were completed in 1938 as in 1937—986 against 1,852. Furthermore, the wells of 1938 were of much smaller average size; in fact, the total initial for 1938 (215,000 barrels) was the lowest in 29 years. Incentives for an active drilling campaign generally were lacking, hence many of the operators who had not migrated to other States "marked time" in 1938 by working over old wells (not recorded as new completions) or testing shallow horizons, particularly in the greater Seminole district where they had been passed up in the haste to reach the prolific Wilcox zone.

Wildcatting in 1938 had considerable success, although no new large fields were uncovered. Considered the most important new field was Ramsey, Payne County, which, though small in area, yielded unusually large wells. Hillsdale, Garfield County, was considered an important find, as it extended the producing area of the State to the northwest and opened a large area to exploration. The Coyle and Meridian fields, Payne and Logan Counties, respectively, were 1938 Wilcox discoveries of considerable promise. Important among deep-sand developments was the drilling of about 40 wells in the old Cement field, Caddo County.

Pennsylvania.—The 30-percent decline in the average price of Pennsylvania Grade crude oil in 1938 greatly depressed field work in Pennsylvania. Oil wells completed in 1938 totaled about 45 percent below 1937. Production, which had increased steadily since 1931, dropped from 19,189,000 barrels in 1937 to 17,426,000 in 1938.

Texas.—Lower demand and introduction of the Saturday and Sunday shut-downs in Texas in 1938 caused the trend of production to turn downward, and 475,614,000 barrels were produced compared with the peak of 510,318,000 barrels in 1937.

No change was made in the Bureau's districts for Texas, which remain as follows: For the monthly publications—Panhandle, West Texas, East Texas proper, Rodessa, Gulf Coast, and "Rest of State"; for the annual chapter—Panhandle, North, West, Central, East, and South Texas, and the Gulf Coast. East Texas in the annual report includes East Texas proper and Rodessa, as well as Van and other fields in that part of the State.

Drilling declined materially in the Panhandle in 1938, and production decreased from 27,617,000 barrels in 1937 to 23,556,000 in 1938. All five producing counties shared in the decline. Natural-gas discoveries outranked oil discoveries in the Panhandle in 1938, as only one oil field was found.

The development of the K-M-A field of Wichita County overshadowed all others in the North Texas district in 1938. About 700 or 800 oil wells were completed in the field in 1938 for a total initial of about 600,000 barrels. Although drilling elsewhere maintained the pace of 1937, production at K-M-A and other fields was held down by proration so that the total output for the district was about the same as in 1937.

Wildcatters, greatly encouraged by the results of deeper drilling in recent years, continued active, and a score or more new productive spots were found in North Texas in 1938. Jones County, on the west edge of the district, led in new discoveries. Outstanding new fields were Steffens, Jones County; Holliday, on the Wichita-Archer County line; and Hull-Silk, Archer County, which had three distinct producing zones.

Production in the West Texas district in 1938 was 72,653,000 barrels, or only slightly under the 75,743,000 barrels produced in 1937. Drilling in 1938 was about 25 percent lower than in 1937, but was partly offset by a gain in the average initial.

Production of crude petroleum in Texas, 1933–37, by districts [1]

[Thousands of barrels]

District	1933	1934	1935	1936	1937
Gulf Coast:					
Anahuac	----------	----------	358	2,606	4,318
Barbers Hill	8,082	6,820	6,765	5,461	4,366
Batson	208	246	588	638	630
Boling	126	209	182	348	545
Conroe	21,215	17,761	15,276	15,229	15,191
Dickinson	----------	(2)	280	719	1,432
Esperson	481	452	395	630	601
Flour Bluff	----------	----------	----------	93	1,607
Friendswood	----------	----------	----------	----------	88
Goose Creek	1,163	1,203	1,069	1,038	860
Greta	1,195	3,936	4,769	5,481	6,635
Hankamer	547	378	565	779	576
Hardin	----------	----------	----------	135	241
Hastings	----------	----------	689	2,408	5,835
Heyser	----------	----------	----------	120	1,515
High Island	2,534	2,747	2,513	2,069	1,183
Hull	1,946	3,453	2,311	1,950	2,492
Humble	1,722	1,188	1,230	1,163	1,217
Luby	----------	----------	----------	----------	80
Manvel	586	1,020	2,467	3,014	3,458
Markham	351	389	459	540	612
Mykawa	70	133	705	1,161	632
Old Ocean	----------	(2)	104	159	447
Orange	312	289	263	250	248
Pierce Junction	1,524	1,196	1,093	1,298	1,243
Placedo	----------	----------	143	1,393	3,082
Plymouth	----------	----------	650	3,400	5,056
Raccoon Bend	1,544	1,489	1,681	1,922	2,002
Refugio	2,105	1,489	1,641	3,228	2,307
Saxet-Saxet Heights	861	775	1,336	7,245	15,763
Segno	----------	----------	----------	----------	472
Silsbee	----------	----------	----------	6	464
Sourlake	453	484	602	561	569
Spindletop	1,149	1,052	962	858	912
Sugarland	2,532	2,183	2,098	1,715	1,322
Thompsons	4,906	4,245	4,123	3,523	4,147
Tomball	233	990	1,899	2,611	3,060
West Columbia	[3] 1,441	1,038	857	773	825
Withers	----------	----------	----------	229	570
Other Gulf Coast	3,716	4,990	6,841	12,235	18,099
Total Gulf Coast	61,002	60,155	64,914	86,988	114,702
East Texas:					
East Texas proper [4]	204,954	181,540	176,859	167,512	170,673
Cayuga	----------	589	1,333	2,137	3,195
Long Lake	(5)	(5)	(5)	374	549
Rodessa	----------	----------	12	3,144	12,626
Sulphur Bluff	----------	----------	----------	----------	1,627
Talco	----------	----------	----------	1,344	9,720
Van	17,077	14,621	14,062	12,508	11,346
Other East Texas	341	311	813	726	589
Total East Texas	222,372	197,061	193,079	187,745	210,325
Central Texas:					
Darst Creek	4,565	3,374	3,298	3,201	2,802
Luling	2,368	2,187	2,055	2,154	2,260
Lytton Springs	405	557	341	328	120
Mexia [6]	2,064	1,947	1,902	1,847	1,678
Salt Flat (Bruner)	2,020	1,637	1,495	1,448	1,586
Other Central Texas	2,108	2,334	4,356	4,896	5,125
Total Central Texas	13,530	12,036	13,447	13,874	13,571
North Texas [7]	26,293	31,558	31,098	33,041	37,580
Panhandle [8]	16,673	20,280	21,369	22,357	27,617
South Texas [9]	7,395	10,154	13,342	21,367	30,780

[1] Figures by districts for 1938 not yet available.
[2] Included under "Other Gulf Coast."
[3] Includes Damon Mound and Nash.
[4] Joiner, Kilgore, Lathrop, and other pools in Cherokee, Gregg, Rusk, Smith, and Upshur Counties.
[5] Included under "Other East Texas."
[6] Includes other fields in Falls, Freestone, Limestone, and Navarro Counties.
[7] 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.
[8] Carson, Gray, Hutchinson, Moore, Potter, and Wheeler Counties.
[9] Includes fields in Duval, Hidalgo, Jim Hogg, Jim Wells, Starr, Webb, and Zapata Counties.

Production of crude petroleum in Texas, 1933–37, by districts—Continued

District	1933	1934	1935	1936	1937
West Texas:					
Andrews	(10)	217	628	857	1,318
Big Lake	6,535	4,476	3,610	2,859	2,648
Chalk-Roberts [11]	6,257	6,563	8,163	9,345	8,663
Crane-Upton	6,396	6,145	6,384	7,843	10,078
Ector	1,944	2,625	3,591	5,759	10,121
Fisher	944	1,633	1,954	1,640	1,164
Hendricks	8,263	7,612	7,670	9,801	15,411
Ward County	2,559	3,479	5,883	8,992	12,561
Yates	20,723	15,991	15,935	13,414	11,388
Other West Texas	1,723	1,531	1,599	1,529	2,391
Total West Texas	55,344	50,272	55,417	62,039	75,743
Total Texas	402,609	381,516	392,666	427,411	510,318

[10] Included under "Other West Texas."
[11] Includes Westbrook and other fields in Glasscock, Howard, and Mitchell Counties.

About a dozen new fields in nearly as many counties were found in 1938. Among these, Dunes, Crane County, and Payton, Pecos County, were most prominent. The Wasson field of Gaines County and the Denver field of Yoakum County were joined, and future drilling promises to link up other productive spots into a field of 50,000 or more acres, the largest in the district. Prospecting in the Ordovician, an expensive type of recreation for wildcatters in West Texas, was generally disappointing in 1938.

Reduced allowables due primarily to the week-end shut-downs were responsible for a decline of production in the East Texas field proper from 170,673,000 barrels in 1937 to 152,143,000 in 1938. The average bottom-hole pressure, a factor in determining the allowable, decreased but slightly in 1938 and actually increased in the last few months of the year. The net drop was from about 1,123 pounds per square inch on January 1 to 1,110 on December 31. Drilling declined sharply, only 1,599 oil wells being brought in during 1938 compared with 2,252 in 1937. However, the average daily initial gain increased from 1,214 barrels in 1937 to 1,282 in 1938.

Production in the other fields of the East Texas district fell from about 40,000,000 barrels in 1937 to about 33,000,000 in 1938. Van bore the brunt of the decrease; the Rodessa and Talco fields produced nearly as much as in the previous year. Several distillate discoveries of questionable significance and one oil field—Navarro Crossing, Houston County—comprised the principal realization from exploration work in 1938.

The Central Texas district, including chiefly the fault-line pools, passed another quiet year, with no important discoveries and with production continuing its gradual decline. Several new fields were found in Bexar and other counties, but they were small.

The rapid rise of production in the South Texas district, often referred to as the Laredo district, was halted in 1938, and production dropped from 30,780,000 barrels in 1937 to just under 30,000,000.

Drilling activity was definitely off, but the number of discoveries probably increased. The principal discoveries in 1938 were along the "Jackson trend," although wildcatting along the Cockfield and Pettus trends yielded favorable results. The trend type of geology probably finds wider use here than anywhere else in the country. Of the new discoveries, South Alice (Jim Wells County), Sun (Starr County), and Kelsey (Jim Hogg County) appeared outstanding. Many of the new fields were 4,000 to 5,000 feet deep, which would be shallow in some parts of the country but is considerably deeper than the average wildcat of this district 10 years ago.

The Texas Gulf Coast was the only district in the State that gained in output in 1938, its production rising from 114,702,000 barrels in 1937 to 115,303,000 in 1938. The small increase was related to changes in the allowables, because drilling and total initial declined as in the rest of the State.

Although Conroe suffered a severe recession in output in 1938 it continued to be far and away the most important producer in the district. The production of most of the old fields declined in 1938, gains at Hastings, Old Ocean, Friendswood, and other fields just offsetting the losses.

For the first time, the number and aggregate estimated importance of the new discoveries in the Texas Gulf Coast were surpassed in the Louisiana Gulf Coast. However, about a dozen new productive spots were uncovered in Coastal Texas, several of which were situated offshore. Of the new discoveries, Cedar Point, Eureka, and Fairbanks appeared outstanding.

Utah.—Field work in Utah in 1938 was devoted to natural gas, and the oil production was only 12,000 barrels.

West Virginia.—Conditions in West Virginia in 1938 favored continuance of the general decline in production evidenced for the last 25 years. The output in 1938 was 3,684,000 barrels compared with 3,845,000 in 1937. The number of oil wells completed declined materially, but the total initial increased.

Wyoming.—Production in Wyoming declined but slightly in 1938—from 19,166,000 barrels in 1937 to 19,004,000 in 1938. Wyoming was one of the few States in which drilling increased; 95 oil wells were completed in 1938 compared with 72 in 1937.

Production in the Salt Creek field continued its slow but steady decline. However, it still held a considerable margin over the second-ranking field, Lance Creek, whose production increased in 1938 following a markedly successful drilling program.

Several new oil and gas fields were discovered, but only one deserves mention here—the Cole Creek field, Natrona County, which produces from about 8,000 feet.

Production of crude petroleum in Wyoming, 1933–37, 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

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

[1] Figures by districts for 1938 not yet available. [2] Garland includes Byron.

WELLS

Owing to the unsettled price situation, drilling for oil and gas declined materially in 1938 from 1937. Total completions in 1938 were about 27,400, or nearly 4,000 fewer holes than in 1937. Of the total completions in 1938 70 percent were oil wells, 8 percent gas wells, and 22 percent dry holes. Compared with 1937 these data indicate chiefly an increase in the ratio of failures (see fig. 4). There were 363,030 producing oil wells at the beginning of 1938, and allowing for the customary percentage of abandonments this total may have reached 374,000 by the end of the year. The average production per well per day, which had increased steadily since 1934, dropped from 9.8 barrels in 1937 to about 9.0 barrels in 1938.

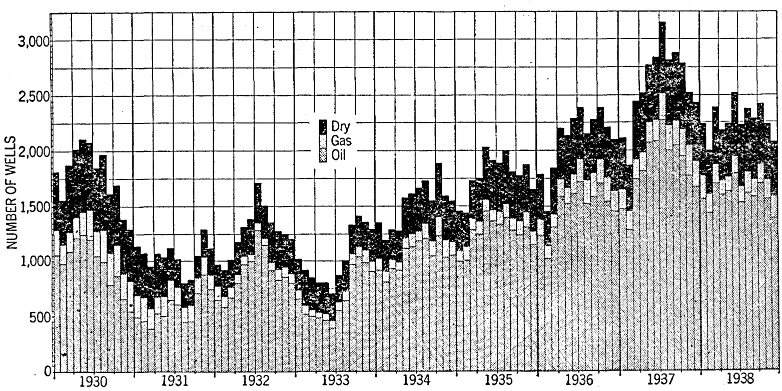

FIGURE 4.—Wells drilled, 1930–38, by months.

Although drilling declined materially in the East Texas field in 1938, it led in number of completions, with Wichita County in second place. The Bradford-Allegany district led in total number of holes drilled, but a large percentage were water-drive holes. The increases in field activity in several Illinois counties were the most spectacular developments in 1938.

Wells drilled for oil and gas in the United States in 1938, by months [1]

Wells	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
													Number	Percent
Oil	1,563	1,440	1,701	1,600	1,632	1,790	1,534	1,624	1,585	1,705	1,558	1,389	19,121	70.4
Gas	209	168	173	129	127	154	145	180	156	168	179	197	[2] 1,985	7.3
Dry	464	391	506	452	479	572	547	566	542	543	494	487	6,043	22.3
Total: 1938	2,236	1,999	2,380	2,181	2,238	2,516	2,226	2,370	2,283	2,416	2,231	2,073	27,149	100.0
1937 [3]	2,107	1,860	2,442	2,515	2,769	2,835	3,153	2,813	2,876	2,786	2,520	2,430	31,106	------

[1] Oil and Gas Journal.
[2] 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.
[3] Water-intake wells not included.

Wells drilled in the United States and estimated average daily initial oil production per well, 1937–38, by States and districts [1]

State and district	1937					1938				
	Oil		Gas	Dry	Total	Oil		Gas	Dry	Total
	Number	Average initial (barrels)				Number	Average initial (barrels)			
Arkansas	103	665	6	78	187	204	683	3	44	251
California [2]	1,147	539	17	314	1,478	993	927	7	265	1,265
Colorado	2	450	2	23	27	7	135	1	10	18
Illinois	272	295	3	117	392	1,806	271	23	408	2,237
Indiana	47	12	39	58	144	46	37	43	69	158
Kansas	1,867	792	357	606	2,830	1,108	581	200	402	1,710
Kentucky	407	35	193	234	834	484	89	91	314	889
Louisiana:										
Gulf Coast	273	510	10	170	453	329	388	10	186	525
Northern	406	440	138	136	680	361	465	116	145	622
Total Louisiana	679	468	148	306	1,133	690	429	126	331	1,147
Michigan	586	525	69	277	932	566	451	28	406	1,000
Montana	135	95	26	56	217	69	78	21	27	117
New Mexico	574	944	27	64	665	494	370	19	67	580
Ohio	316	22	497	432	1,245	189	23	433	288	910
Oklahoma	1,852	366	123	697	2,672	986	218	160	545	1,691
Pennsylvania and New York	2,861	3	186	93	3,140	2,378	4	166	95	2,639
Texas:										
Gulf Coast	1,321	492	61	313	1,695	1,106	425	36	269	1,411
East Texas proper	2,252	1,214		77	2,329	1,599	1,282	1	45	1,645
West Texas	2,464	819	11	331	2,806	1,788	877	16	241	2,045
Rest of State	4,989	238	353	2,099	7,441	4,399	319	288	2,022	6,709
Total Texas	11,026	593	425	2,820	14,271	8,892	618	341	2,577	11,810
West Virginia	197	5	650	171	1,018	114	13	484	126	724
Wyoming	72	566	12	43	127	95	480	19	43	157
Other States			54	31	85			71	26	97
Total United States	22,143	480	[3] 2,834	6,420	31,397	19,121	457	[3] 2,236	6,043	27,400

[1] Oil and Gas Journal, except California. [2] American Petroleum Institute.
[3] Total by States does not agree with total by months published elsewhere in the Yearbook, as former has been revised on basis of annual data from State officials.

Producing oil wells in the United States and average production per day in 1937, by States and districts [1]

State and district	Producing oil wells: Approximate number, Dec. 31	Producing oil wells: Average production per well per day (barrels)	State and district	Producing oil wells: Approximate number, Dec. 31	Producing oil wells: Average production per well per day (barrels)
Arkansas	2,670	12.1	Ohio	28,500	0.3
California [2]	13,460	50.9	Oklahoma	55,900	11.3
Colorado	200	21.4	Pennsylvania	82,800	.6
Illinois	14,110	1.5			
Indiana	1,240	1.9	Texas:		
Kansas	21,850	9.3	Gulf Coast	6,640	51.8
Kentucky	13,700	1.1	East Texas proper	24,100	20.6
			West Texas	7,670	32.2
Louisiana:			Rest of State	38,950	11.1
Gulf Coast	1,110	167.5			
Northern	3,050	26.7	Total Texas	77,360	19.4
			West Virginia	18,400	.6
Total Louisiana	4,160	62.6	Wyoming	3,350	15.5
Michigan	1,780	29.0	Other States [3]	130	
Montana	1,600	10.4			
New Mexico	1,920	67.2	Total wells	363,030	9.8
New York	19,900	.8			

[1] Figures for 1938 not yet available.
[2] American Petroleum Institute.
[3] Missouri, Tennessee, and Utah.

Drilling activity in leading districts of the United States, 1937–38 [1]

District	State	Completions 1937	Completions 1938	District	State	Completions 1937	Completions 1938
Allegany County [2]	Michigan	87	309	Fayette County	Illinois	5	518
Barton County	Kansas	299	262	Lea County	New Mexico	576	469
Bradford-Allegany	Pennsylvania - New York.	3,810	2,168	Marion County	Illinois	121	693
				Pottawatomie County	Oklahoma	72	174
				Rodessa	Arkansas-Louisiana-Texas.	286	197
Caddo Parish	Louisiana	226	134				
Clay County	Illinois	99	153				
Clinton County	do	27	391	Torrance	California	19	131
Daviess County	Kentucky	50	145	Union County	Arkansas	41	136
East Texas	Texas	2,329	1,645	Wichita County	Texas	392	1,033
Ector County	do	507	638	Wilmington	California	355	263
Fairbanks	do	5	129	Yoakum County	Texas	18	161

[1] Oil and Gas Journal, except Michigan.
[2] Department of Conservation, Michigan.

STOCKS

The trend of crude-oil stocks in the first quarter of 1938 gave every indication that the experience of 1937 would be repeated—that is, that stocks would be built up. However, drastic revisions in the allowables in April and May resulted in material declines in production. This allowed the expanding demand to catch up so that large withdrawals from stocks were made in May, June, July, and October and smaller ones in August, September, and November. Marked decreases in crude runs to stills during the year and exports in December resulted in an increase in stocks. The total for refinable grades on hand December 31, 1938, was 274,353,000 barrels compared with 305,091,000 on hand the first of the year. These totals are exclusive of stocks of unmixed heavy crude oil in California, segregated from fuel-oil stocks the first of the year, some of which is run to stills each month primarily to produce lubricants and asphalt. These stocks increased from 14,505,000 barrels the first of 1938 to 16,467,000 on December 31.

The net withdrawal from stocks of refinable grades of crude oil in 1938 was more evident in terms of days' supply than in quantity. The low point of days' supply for 1938 was 80, reached October 31—the lowest point in about 20 years.

Refinery stocks changed relatively little in 1938, the total rising about 500,000 barrels to 51,551,000 on December 31. Pipe-line and tank-farm stocks of Pennsylvania Grade crude oil increased materially, which contributed to the market weakness for this grade of oil. Substantial withdrawals were made from all the common grades of Mid-Continent crude oil. In 1938 pipe-line and tank-farm stocks in the Rocky Mountain district fell to the lowest point since 1923. The practice of converting surplus crude into products more easily stored was followed quite generally in California in 1938. However, although this held the increase in crude-oil stocks to under 6,000,000 barrels, stocks of products, mostly residual fuel oil, increased nearly four times that much.

Significant among the changes in crude-oil stocks by States of origin were the large withdrawals of oil originating in Oklahoma and Texas, an increase in Illinois oil, reflecting the new developments, and heavier reductions from the stocks of old oil in Wyoming. Stocks of foreign crude changed but little during 1938, the total at the close of 1938 being 3,521,000 barrels, or somewhat less than 2 months' supply.

Stocks of crude petroleum, natural gasoline, and refined products in the United States, at end of year, 1934–38

[Thousands of barrels]

	1934	1935	1936	1937	1938 [1]
Crude petroleum (gasoline bearing):					
At refineries	64,099	59,148	46,846	51,041	51,551
Pipe line and tank farm	264,625	245,178	230,499	244,545 [2] 243,552	211,931
Producers	8,530	10,529	11,234	11,240 [2] 10,498	10,871
Total	[3] 337,254	[3] 314,855	[3] 288,579	[3] 306,826 [2] 305,091	274,353
California heavy crude (nongasoline bearing)	(4)	(4)	(4)	[2] 14,505	16,467
Total crude petroleum	[3] 337,254	[3] 314,855	[3] 288,579	[3] 306,826 [2] 319,596	290,820
Natural gasoline	4,216	3,698	4,055	4,758	4,830
Refined products [5]	[3] 222,682	[3] 223,361	[3] 226,595	[3] 253,413 [2] 239,632	259,613
Grand total	564,152	541,914	519,229	564,997 [2] 563,986	555,263

[1] Subject to revision.
[2] For comparison with succeeding year.
[3] California heavy crude and fuel oil included under refined products as residual fuel oil.
[4] Data not available.
[5] Includes also equivalents for wax, coke, and asphalt in barrels.

Stocks of crude petroleum in the United States in 1938, by States of location and origin and by months [1]

[Thousands of barrels]

State	Jan. 1	Jan. 31	Feb. 28	Mar. 31	Apr. 30	May 31	June 30	July 31	Aug. 31	Sept. 30	Oct. 31	Nov. 30	Dec. 31
LOCATION													
Arkansas	2,541	2,441	2,655	2,659	2,673	2,557	2,310	2,291	2,415	2,332	2,278	2,291	2,447
California	29,414	29,296	31,145	31,579	31,392	31,488	32,925	32,895	33,278	33,670	34,764	35,975	37,064
Illinois	10,913	11,340	11,356	10,998	11,357	11,501	11,511	11,725	11,608	11,631	11,598	11,311	11,752
Indiana	2,962	3,031	3,120	3,271	3,198	3,048	3,018	3,127	3,231	3,206	3,133	3,198	3,190
Kansas	10,715	10,885	10,741	10,694	10,963	10,189	9,779	8,935	8,841	8,687	8,654	8,301	7,936
Louisiana and Alabama	11,848	12,047	11,531	11,095	11,383	11,041	11,375	11,995	12,772	13,096	13,390	12,679	11,622
Maryland [2]	2,882	2,501	2,839	2,731	2,280	2,627	2,516	2,529	2,215	2,248	2,007	2,163	2,347
Michigan and Kentucky	1,740	1,743	1,850	2,035	2,171	2,158	2,076	2,035	2,007	1,978	2,208	2,131	2,320
Missouri and Iowa	4,000	4,122	4,077	4,183	4,055	4,088	4,239	4,172	4,108	4,098	4,047	3,839	3,965
Montana and Colorado	1,949	1,932	1,886	1,880	2,033	2,076	2,064	2,131	2,111	1,929	1,970	2,050	2,064
New Jersey	6,294	6,917	7,216	7,691	7,803	6,916	5,877	6,610	5,888	5,660	5,287	5,299	5,842
New Mexico	1,114	1,143	1,126	1,150	1,193	1,158	1,145	1,295	1,216	1,172	1,196	1,274	1,238
New York	1,150	1,163	1,047	1,239	1,005	1,034	1,153	1,239	1,125	1,297	1,207	1,239	1,149
Ohio	8,057	8,218	7,871	8,196	8,265	8,295	8,457	8,216	8,184	8,279	8,201	8,105	8,095
Oklahoma	70,823	71,511	72,012	72,906	71,834	69,397	66,504	63,416	60,886	59,390	57,038	54,864	53,506
Pennsylvania	6,544	6,604	6,674	7,035	7,251	7,024	7,264	6,965	6,808	6,708	5,932	5,949	6,630
Texas	107,388	106,602	104,573	105,425	104,064	100,608	97,113	96,713	97,185	95,459	93,018	91,690	92,403
West Virginia	2,151	2,232	2,182	2,224	2,224	2,305	2,369	2,390	2,402	2,440	2,454	2,410	2,338
Wyoming [3]	22,606	22,467	22,448	22,412	22,153	21,473	20,939	19,985	19,360	18,856	18,425	18,387	18,445
Total United States	305,091	306,195	306,349	309,403	307,297	298,983	292,634	288,664	285,640	282,136	276,807	273,155	274,353
ORIGIN													
Arkansas	3,706	3,664	3,934	3,962	3,932	3,735	3,393	2,967	3,017	3,093	2,962	2,937	3,089
California	29,459	29,341	31,188	31,669	31,504	31,624	33,151	33,138	33,548	33,975	34,999	36,064	37,193
Illinois and Indiana	9,913	9,817	9,735	9,913	10,227	10,403	10,421	10,618	10,657	11,040	11,102	11,274	11,403
Kansas	6,478	6,889	7,101	7,082	7,000	6,254	6,384	6,164	6,347	6,269	6,324	6,683	6,861
Louisiana	12,953	13,378	13,302	13,623	13,358	13,021	13,822	14,197	14,416	14,852	15,185	14,173	13,806
Michigan and Kentucky	2,038	2,083	1,961	2,150	2,245	2,338	2,414	2,245	2,120	2,133	2,352	2,074	2,377
Montana and Colorado	1,894	1,899	1,867	1,867	2,029	2,050	2,021	2,072	2,043	1,888	1,942	1,952	1,909
New Mexico	10,178	9,959	9,472	9,075	9,438	9,125	8,549	7,732	7,862	7,830	7,764	7,468	7,358
Ohio	893	868	982	973	899	859	892	944	893	877	800	797	756
Oklahoma	90,513	91,216	91,160	91,466	90,794	88,066	84,338	81,234	78,945	77,667	74,829	71,692	70.073
Pennsylvania, New York, and West Virginia	4,846	4,807	4,830	5,091	5,179	5,361	5,504	5,593	5,679	5,681	5,649	5,494	5,422
Texas	105,691	105,636	104,432	105,845	104,628	100,888	97,055	97,609	97,275	94,852	91,342	90,921	91,565
Wyoming	23,034	22,906	22,890	22,883	22,518	21,945	21,579	20,760	20,122	19,439	19,040	18,989	19,020
Foreign	3,495	3,732	3,495	3,804	3,546	3,314	3,111	3,391	2,716	2,540	2,517	2,637	3,521
Total United States	305,091	306,195	306,349	309,403	307,297	298,983	292,634	288,664	285,640	282,136	276,807	273,155	274,353

[1] Subject to revision. [2] Includes Delaware, Georgia, Massachusetts, Rhode Island, South Carolina, and Virginia. [3] Includes Nebraska, South Dakota, and Utah.

Stocks of crude petroleum in the United States, in 1938, by districts and months [1]

[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	833	730	741	777	783	780	710	803	829	879	849	846	765
Other Appalachian (including Kentucky)	388	433	430	422	449	507	480	473	455	387	454	457	496
Lima-Northeastern Indiana-Michigan	560	499	373	419	363	449	590	447	360	439	466	454	515
Illinois-Southwestern Indiana	163	148	206	171	320	321	328	315	436	535	482	564	659
North Louisiana and Arkansas	3,375	3,385	3,766	3,812	3,735	3,440	3,652	2,848	3,034	3,157	2,497	1,979	2,244
West Texas and Southeastern New Mexico	4,858	5,519	5,810	5,439	5,125	5,194	5,276	4,531	4,119	4,029	3,905	4,195	3,800
East Texas	4,224	5,060	4,980	5,182	5,283	5,279	4,266	4,065	4,165	3,731	3,421	2,924	3,061
Oklahoma, Kansas, North Texas, etc.	13,726	14,315	13,470	14,012	14,651	13,881	13,680	14,347	14,655	14,926	14,934	14,465	14,130
Gulf Coast	8,937	9,029	9,662	9,560	9,478	9,580	9,755	10,198	9,851	10,252	9,411	9,854	10,000
Rocky Mountain	2,227	2,254	2,295	2,224	2,242	2,356	2,466	2,256	2,104	2,104	2,195	2,011	2,030
California	8,255	7,805	8,187	7,638	8,376	8,141	8,614	7,900	8,997	8,003	9,292	9,743	10,330
Foreign	3,495	3,732	3.495	3,804	3,546	3,314	3,111	3,391	2,716	2,540	2,517	2,637	3,521
Total at refineries	51,041	52,909	53,415	53,460	54,351	53,242	52,928	51,574	51,721	50,982	50,423	50,129	51,551
Pipe-line and tank-farm stocks, by fields of origin:													
Appalachian:													
Pennsylvania Grade	4,011	4,084	4,116	4,325	4,424	4,583	4,823	4,839	4,928	4,885	4,841	4,696	4,678
Other Appalachian (including Kentucky)	710	648	680	739	814	841	899	890	877	843	816	760	726
Lima-Northeastern Indiana-Michigan	797	881	950	1,059	1,017	923	828	850	773	778	890	662	880
Illinois-Southwestern Indiana	9,587	9,486	9,351	9,594	9,729	9,892	9,913	10,108	10,021	10,305	10,390	10,430	10,484
North Louisiana and Arkansas	6,077	6,241	6,069	6,202	6,061	5,686	5,836	6,066	5,905	5,884	6,045	6,033	5,521
West Texas and Southeastern New Mexico	26,851	25,656	24,590	25,065	24,487	23,280	21,604	21,134	20,353	20,590	19,821	19,572	19,757
East Texas	22,959	22,078	23.106	22,724	22,565	20,040	18,535	18,604	18,962	17,521	15,921	15,644	15,698
Oklahoma, Kansas, North Texas, etc.	115,027	115,522	115,514	116,063	115,495	112,074	107,975	104,882	102,782	100,700	97,430	94,146	93,921
Gulf Coast	16,804	17,020	15,559	15,784	15,346	15,472	15,692	16,095	16,915	16,884	17,812	17,903	17,776
Rocky Mountain	22,397	22,258	22,182	22,261	22,029	21,367	20,794	20,219	19,712	18,882	18,366	18,509	18,478
California [2]	18,332	18,030	19,091	19,629	19,904	20,446	21,520	22,210	21,631	23,068	22,794	23,241	24,012
Total pipe-line and tank-farm	243,552	241,904	241,208	243,445	241,871	234,604	228,419	225,897	222,859	220,340	215,126	211,596	211,931
Producers' stocks	10,498	11,382	11,726	12,498	11,075	11,137	11,287	11,193	11,060	10,814	11,258	11,430	10,871
Total United States: 1938 [2]	305,091	306,195	306,349	309,403	307,297	298,983	292,634	288,664	285,640	282,136	276,807	273,155	274,353
1937 [3]	288,579	287,159	290,372	297,896	304,706	308,719	309,313	309,231	311,440	310,271	309,165	306,457	306,826

[1] Subject to revision.

[2] Excludes stocks of California heavy crude as follows (thousands of barrels): Jan. 1, 14,505; Jan. 31, 15,026; Feb. 28, 15,563; Mar. 31, 16,069; Apr. 30, 16,887; May 31, 17,353; June 30, 17,425; July 31, 17,646; Aug. 31, 17,575; Sept. 30, 17,535; Oct. 31, 17,143; Nov. 30, 16,765; Dec. 31, 16,467. Data not available prior to 1938.

[3] Revisions of preliminary figures for 1937 (Minerals Yearbook, 1938, p. 840) are as follows (thousands of barrels): Refinery stocks, July 31, California 8,051, total 56,100; pipe-line and tank-farm stocks, July 31, Pennsylvania Grade, 3,639; West Texas and Southeastern New Mexico, 25,787; Oklahoma, Kansas, North Texas, etc., 113,850; Rocky Mountain, 22,813; and producers' stocks, Jan. 1, 11,234; Jan. 31, 11,708; Feb. 28, 11,304; Mar. 31, 11,451; Apr. 30, 11,115; May 31, 11,311; June 30, 11,267; July 31, 11,360; Aug. 31, 11,460; Sept. 30, 11,466; Oct. 31, 11,610; Nov. 30, 11,498; Dec. 31, 11,240.

CONSUMPTION AND DISTRIBUTION

Runs to stills.—Total crude run to stills in 1938 declined over 18 million barrels from the record of 1,183 million barrels in 1937. The decrease was all in domestic crude runs as foreign crude runs remained virtually unchanged. Imports of Mexican crude were almost 2 million barrels less than in 1937, and imports from Venezuela increased slightly.

Crude runs in the Texas Gulf Coast district rose to 308 million barrels, an increase of 26 million barrels (9 percent) over 1937. The continued upward trend in this district presented the effects of increased refinery capacity and the very active export demand for refined products in 1938. The only other increase in runs was in the Rocky Mountain district a gain of 6 percent over 1937. All other districts declined from 1937. Compared to 1937 runs in the Texas Inland district decreased 11 percent, the East Coast district 9 percent, the Oklahoma, Kansas, and Missouri district 8 percent, the Louisiana Louisiana Gulf Coast district 8 percent, the Appalachian and Arkansas and Louisiana Inland districts 3 percent, and the Indiana, Illinois, Kentucky, and California districts 1 percent.

The material recession in the domestic demand for residual fuel oil was an important factor in the decrease in the runs to stills in 1938. Furthermore, efforts were being made in most districts east of California to liquidate the excess stocks of refined products accumulated in 1937. Many smaller refineries in inland locations were inoperative because of the relatively greater decline in the price of finished products compared to the price of crude petroleum. In California, the large increase in the stocks of finished oils, particularly residual fuel, indicated that runs were maintained at a far higher rate than demand warranted.

Runs to stills of crude petroleum in the United States in 1938, by districts and months

[Thousands of barrels]

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
East Coast:													
Domestic	13,947	12,352	12,987	12,695	12,931	12,491	12,709	13,378	12,926	13,734	13,069	13,254	156,473
Foreign	1,799	2,098	2,194	2,011	2,195	2,259	2,202	2,240	1,557	2,254	1,803	1,521	24,133
Total East Coast	15,746	14,450	15,181	14,706	15,126	14,750	14,911	15,618	14,483	15,988	14,872	14,775	180,606
Appalachian	3,449	3,174	3,039	3,208	3,383	3,251	3,360	3,344	3,175	3,260	3,143	3,394	39,180
Indiana, Illinois, Kentucky, etc.	13,567	12,358	12,921	12,624	13,229	12,914	13,955	13,810	14,095	15,225	14,369	14,073	163,140
Oklahoma, Kansas, and Missouri	8,716	8,038	8,985	9,233	10,178	9,537	10,261	10,007	9,412	9,144	8,752	8,880	111,143
Texas Inland	5,906	5,449	5,314	5,512	5,412	5,566	5,932	5,875	5,661	5,491	5,716	5,089	66,923
Texas Gulf Coast:													
Domestic	25,195	22,464	25,106	25,521	26,278	25,101	26,088	26,992	25,032	26,068	25,750	26,744	306,339
Foreign	1	19	21	----------	18	37	36	66	158	370	426	415	1,567
Total Texas Gulf Coast	25,196	22,483	25,127	25,521	26,296	25,138	26,124	27,058	25,190	26,438	26,176	27,159	307,906
Louisiana Gulf Coast:													
Domestic	4,222	3,612	4,183	3,887	4,271	3,426	3,826	3,854	3,548	3,805	3,855	3,927	46,416
Foreign	44	3	26	59	19	78	41	30	42	84	10	51	487
Total Louisiana Gulf Coast	4,266	3,615	4,209	3,946	4,290	3,504	3,867	3,884	3,590	3,889	3,865	3,978	46,903
Arkansas and Louisiana Inland	1,955	1,681	1,882	2,087	2,180	1,851	1,962	1,983	1,917	2,467	2,071	2,053	24,089
Rocky Mountain	1,962	1,739	1,889	1,800	2,118	2,129	2,319	2,579	2,269	2,102	1,997	1,888	24,791
California	17,137	15,192	17,338	17,038	17,026	15,240	17,165	17,194	17,198	16,783	16,348	16,675	200,334
Total domestic	96,056	86,059	93,644	93,605	97,006	91,506	97,577	99,016	95,233	98,079	95,070	95,977	1,138,828
Total foreign	1,844	2,120	2,241	2,070	2,232	2,374	2,279	2,336	1,757	2,708	2,239	1,987	26,187
Total United States	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
Daily average	3,158	3,149	3,093	3,189	3,201	3,129	3,221	3,269	3,233	3,251	3,244	3,160	3,192

Distribution.—Receipts of domestic and foreign crude petroleum at refineries in the United States totaled 1,073 million barrels in 1936 and 1,191 million in 1937, but dropped to 1,167 million in 1938. Interstate receipts of domestic crude were 445 million barrels in 1938, compared to 487 million in 1937. This represented a relative decline in interstate shipments from 41 percent of the total receipts in 1937 to 38 percent in 1938. Intrastate receipts of domestic crude amounted to 696 million barrels in 1938 (60 percent of the total) compared with 676 million barrels (57 percent of the total) in 1937. Receipts of foreign crude fell 1 million barrels. The increase in the relative proportion of intrastate receipts continued the trend of recent years and reflects the growth in the local refining of Texas production in the Gulf Coast district. However, the trend was accentuated by a decline in runs in the East Coast district and the maintenance of excessive runs in California.

Refinery receipts of crude in 1938, 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. Compared to 1937 the percentage of pipe-line shipments increased 2 percent, while shipments by boat dropped by about the same amount. The most important boat movement of crude is from Gulf ports to the East Coast. These shipments decreased from 171 million barrels in 1937 to 151 million in 1938.

Exports of domestic crude have increased steadily in recent years. The 77 million barrels exported in 1938 represented an increase of 10 million over 1937. Texas was the largest exporter in 1938, with 34 million barrels, followed by California, with 28 million, and Oklahoma, with 12 million.

Approximately 39 percent of the total movement of domestic crude petroleum from producing fields to refineries was interstate and 61 percent intrastate.

Receipts of crude petroleum at refineries in the United States, 1934–38, by methods of transportation

[Millions of barrels]

	1934 [1]	1935	1936 [1]	1937	1938 [2]
By boat:					
Intrastate	42.4	55.4	68.6	78.5	74.1
Interstate	154.5	164.9	184.9	201.8	182.8
Foreign	35.6	32.2	32.3	27.5	26.4
Total by boat	232.5	252.5	285.8	307.8	283.3
By pipe lines:					
Intrastate	433.2	466.2	517.3	569.6	600.1
Interstate	206.0	220.9	247.2	276.7	254.3
Total by pipe lines	639.2	687.1	764.5	846.3	854.4
By tank car and truck:					
Intrastate	18.4	15.7	14.6	28.2	21.9
Interstate	7.9	9.7	7.6	8.5	7.8
Total by tank car and truck	26.3	25.4	22.2	36.7	29.7
Grand total	898.0	965.0	1,072.5	1,190.8	1,167.4

[1] Revised figures.
[2] Subject to revision.

Summary of crude petroleum receipts and consumption at refineries in the United States in 1938, by consuming States [1]

[Thousands of barrels]

Consuming State	Origin of receipts						Change in refinery stocks	Crude runs to stills	Fuel and losses
	Intrastate	Interstate				Foreign			
		Oklahoma	Texas	Other States	Total				
Arkansas	9,654		22	6	28		−251	9,950	−17
California	202,875						1,991	200,334	550
Colorado	1,312			405	405		−67	1,773	11
Georgia [2]			3	115	118	1,833	−214	2,165	
Illinois	8,027	20,950	2,406	15,682	39,038		34	46,996	35
Indiana	4	40,986	4,938	21,748	67,672		225	67,452	−1
Kansas	33,305	13,148	72		13,220		−400	46,912	13
Kentucky [3]	5,829	200		2,129	2,329		117	8,034	7
Louisiana [4]	29,510	277	25,098	5,346	30,721	482	−663	61,042	334
Maryland			6,776	3,495	10,271	2,253	−113	12,525	112
Massachusetts [5]			10,342	613	10,955	1,146	−208	12,286	23
Michigan	11,760	3,756		113	3,869		59	15,556	14
Missouri		2,030	170	4,486	6,686		−3	6,689	
Montana	4,122			1,639	1,639		24	5,729	8
New Jersey		4,371	37,074	20,111	61,556	6,721	−609	68,656	230
New Mexico	1,431		394		394		2	1,814	9
New York:									
East			5,519		5,519	3,079	−70	8,667	1
West	3,606	2,479		1,026	3,505		57	7,053	1
Ohio:									
East	1,751	3,128		7,111	10,239		46	11,942	2
West	569	14,796	420	9,297	24,513		−4	25,102	−16
Oklahoma	54,884		29	2,638	2,667		−131	57,542	140
Pennsylvania:									
East	31	5,622	52,794	8,655	67,071	9,262	−5	76,307	62
West	14,468	1,797		844	2,641		−133	17,232	10
Texas	298,939	15,092		60,432	75,524	1,636	988	374,829	282
Utah			255	2,743	2,998		124	2,874	
West Virginia	1,786	647		500	1,147		−21	2,953	1
Wyoming [6]	12,238			132	132		−265	12,601	34
Total United States	696,101	129,279	146,312	169,266	444,857	26,412	510	1,165,015	1,845
Daily average	1,907	354	401	464	1,219	72	1	3,192	5

[1] Subject to revision.
[2] Includes Delaware, South Carolina, and Virginia.
[3] Includes Tennessee.
[4] Includes Alabama.
[5] Includes Rhode Island.
[6] Includes Idaho, Nebraska, and South Dakota.

Receipts of crude petroleum at refineries represent the principal data for determining the trend of market demand by States. In 1938 Texas, Oklahoma, California, Louisiana, Kansas, and New Mexico supplied about 90 percent of the refinery receipts of domestic crude compared to 92 percent in 1937.

Total refinery receipts of Texas crude decreased by 15 million barrels—from 460 million in 1937 to 445 million in 1938. Deliveries to refineries in Texas amounted to 299 million barrels (67 percent of the total) and increased almost 19 million barrels over 1937, while deliveries to refineries in other States declined by 33 million barrels. These figures indicate continuance of the trend to refine a larger proportion of State production in the Texas Gulf district. Exports of Texas crude amounted to about 34 million barrels, a gain of 4 million from 1937.

Domestic refinery receipts of Oklahoma crude decreased by 23 million barrels—from 207 million in 1937 to 184 million in 1938. Deliveries to Oklahoma refineries declined by only 4 million barrels compared to a decrease of 19 million barrels to other States. Exports of Oklahoma crude totaled about 12 million barrels, an increase of over 3 million from 1937. The sharp decline in State production, although partly offset by a considerable liquidation of accumulated stocks of Oklahoma origin, indicates a relative decline in the market position of Oklahoma crude.

The deliveries of California crude to domestic refineries decreased slightly—from 206 million barrels in 1937 to 204 million in 1938. Normally, shipments are all intrastate, but in 1938 about 1 million barrels went to the East Coast district. The large increases in stocks of refined oils indicate that runs to stills were considerably above actual requirements. Exports of crude petroleum rose from 23 million barrels in 1937 to almost 28 million in 1938.

Receipts of crude petroleum by refinery districts, 1937–38, by States of origin

[Thousands of barrels

Refinery district	State of origin									
	Texas		Oklahoma		Louisiana		Kansas		New Mexico	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
East Coast	126,674	112,508	12,534	9,993	19,043	16,933			9,042	10,237
Appalachian	160		13,034	8,051						
Indiana, Illinois, Kentucky, etc	12,474	7,764	85,795	80,688	255	217	26,727	24,189	10,260	10,288
Oklahoma, Kansas, and Missouri	2,338	271	76,823	70,062			40,109	36,479		
Texas Inland	71,898	62,912	1,073	1,240	670	481			2,184	2,049
Texas Gulf Coast	208,544	236,027	17,201	13,852	40,497	37,312			14,953	19,986
Louisiana Gulf Coast	26,314	19,213	434	277	19,451	22,877			1,714	267
Arkansas and Louisiana Inland	11,143	5,907			5,370	6,639				
Rocky Mountain	500	649							1,478	1,455
Total United States	460,045	445,251	206,894	184,163	85,286	84,459	66,836	60,668	39,631	44,282

There was little change in 1938 in the demand for Louisiana crude, as deliveries to domestic refineries continued at about 85 million barrels, and exports of crude were virtually the same as in 1937. An increase of 5 million barrels in crude delivered to refineries within the State about offset the decline in interstate shipments to other districts.

The market for Kansas crude declined, owing to the rise in production in Illinois and to eastward shipments from Wyoming. Deliveries of Kansas crude to refineries fell from 67 million barrels in 1937 to 61 million in 1938, and the decrease was divided about equally between intrastate and interstate deliveries.

The market for New Mexico crude continued to increase, but at a slower rate. Deliveries to refineries rose in 1938 to about 44 million barrels, an increase of 5 million. This increase was all in interstate shipments and mainly to the Texas Gulf Coast refinery district.

The total production of crude petroleum in Illinois rose to about 24 million barrels in 1938, an increase of about 16 million barrels. Deliveries of crude to refineries within the State rose from 5 to 8 million barrels, and large additional shipments were made to refineries in adjacent States. The rapid expansion in the supply of Illinois crude was a serious competitive factor in the markets formerly supplied by crude from more distant sources.

Distribution of crude petroleum in the United States in 1938, by States [1]

[Thousands of barrels]

State	Production	Imports	Receipts from other States: Quantity	Receipts from other States: State	Runs to stills	Exports	Deliveries to other States: Quantity	Deliveries to other States: State	Net changes in total crude stocks by location
Arkansas	18,077		28	La. and Tex.	9,950		5,683	La., N. J., Pa., and Tex.	−94
California	249,749				200,334	27,604	923	N. J., and Pa.	9,612
Colorado	1,412		405	N. Mex. and Wyo.	1,773		712	Utah	32
Georgia [2]		1,833	118		2,165				−214
Illinois	23,929		39,038	Ind., Kans., Ky., La., N. Mex., Okla., and Tex.	46,996	530	12,133	Ky. and Ohio	839
Indiana	969		67,672	Kans., La., N. Mex., Okla., Tex., and Wyo.	67,452		998	Ill. and Ky.	228
Kansas	59,587		13,220	Okla. and Tex.	46,912		27,363	Ill., Ind., Mo., and Okla.	−2,779
Kentucky-Tennessee.	5,853		2,329	Ill., Ind., and Okla.	8,034			Ill.	191
Louisiana	94,812	482	[3] 30,721	Ark., N. Mex., Okla., and Tex.	[3] 61,042	2,400	54,949	Ark., Ill., Ind., Md., N. J., Ohio, Pa., and Tex.	[3] −226
Maryland		2,253	10,271	La., N. Mex., and Tex.	12,525				−113
Massachusetts [4]		1,146	10,955	N. Mex. and Tex.	12,286				−208
Michigan	19,211		3,869	Okla.	15,556		7,236	Ohio	389
Missouri	[5] 36		6,686	Kans., Okla., Tex., and Wyo.	6,689				−13
Montana	4,907		1,639	Wyo.	5,729	356	288	Wyo.	83
New Jersey		6,721	61,556	Ark., Calif., La., N. Mex., N. Y., Okla., Pa., Tex., and W. Va.	68,656				−452
New Mexico	35,759		394	Tex.	1,814	353	42,851	Colo., Ill., Ind., La., Md., Mass., N. J., Pa., Tex., and Utah.	124
New York	5,045	3,079	9,024	Okla., Pa., and Tex.	15,720		252	N. J. and Pa.	−1
Ohio	3,298		34,752	Ill., La., Mich., Okla., Tex., and W. Va.	37,044		450	Pa. and W. Va.	38
Oklahoma	174,882		2,667	Kans. and Tex.	57,542	12,188	129,279	Ill., Ind., Kans., Ky., La., Mich., Mo., N. J., N. Y., Ohio, Pa., Tex., and W. Va.	−17,317
Pennsylvania	17,426	9,262	69,712	Ark., Calif., La., N. Mex., N. Y., Ohio, Okla., Tex., and W. Va.	93,539		4,976	N. J. and N. Y.	86
Texas	475,614	1,636	75,524	Ark., La., N. Mex., and Okla.	374,829	33,711	146,312	Ala., Ark., Ill., Ind., Kans., La., Md., Mass., Mo., N. J., N. Mex., N. Y., Ohio, Okla., Pa., R. I., and Utah.	−14,985
Utah	([5])		2,998	Colo., N. Mex., Tex., and Wyo.	2,874				124
West Virginia	3,684		1,147	Ohio and Okla.	2,953		1,077	N. J., Ohio, and Pa.	187
Wyoming	19,004		132	Mont.	[6] 12,601	131	9,375	Colo., Ind., Mo., Mont., and Utah.	[6] −4,307
Total United States.	1,213,254	26,412	444,857		1,165,015	77,273	444,857		−28,776

[1] Subject to revision.
[2] Includes South Carolina and Virginia.
[3] Includes Alabama.
[4] Includes Rhode Island.
[5] Missouri includes Utah.
[6] Includes Idaho, Nebraska, and South Dakota.

PRICES AND VALUE

The average value of crude petroleum at wells, which increased in both 1936 and 1937, dropped in 1938, owing to the almost general price cuts, averaging about 15 cents per barrel, in the first half of October. The estimated value for 1938 is $1.15 per barrel compared with $1.18 in 1937. From the standpoint of historical interest the 1938 average ($1.15) was just under the averages of 1878 and 1928 and just over the average of 1899. Most of the other annual averages in the 60-year interval were lower.

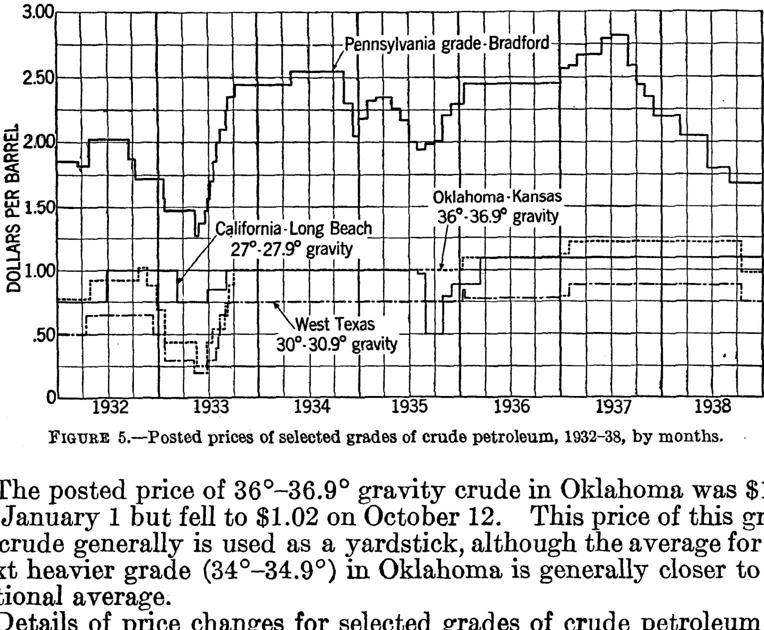

FIGURE 5.—Posted prices of selected grades of crude petroleum, 1932–38, by months.

The posted price of 36°–36.9° gravity crude in Oklahoma was $1.22 on January 1 but fell to $1.02 on October 12. This price of this grade of crude generally is used as a yardstick, although the average for the next heavier grade (34°–34.9°) in Oklahoma is generally closer to the national average.

Details of price changes for selected grades of crude petroleum are shown in the tables that follow and in figure 5.

Average monthly prices per barrel for selected grades of crude petroleum at wells in 1938

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	$2.20	$1.88	$1.35	$1.22	$0.93	$0.88	$1.35	$1.21	$1.10
February	2.20	1.88	1.35	1.22	.93	.88	1.35	1.21	1.10
March	2.08	1.79	1.35	1.22	.93	.88	1.35	1.21	1.10
April	2.05	1.71	1.35	1.22	.93	.88	1.35	1.21	1.10
May	2.05	1.71	1.35	1.22	.93	.88	1.35	1.21	1.10
June	1.90	1.56	1.35	1.22	.93	.88	1.35	1.21	1.10
July	1.80	1.46	1.35	1.22	.93	.88	1.35	1.21	1.10
August	1.80	1.46	1.35	1.22	.93	.88	1.34	1.21	1.10
September	1.68	1.34	1.34	1.22	.93	.88	1.25	1.21	1.10
October	1.68	1.34	1.25	1.05	.85	.85	1.15	1.13	1.10
November	1.68	1.34	1.15	1.02	.81	.75	1.10	1.08	1.10
December	1.68	1.34	1.15	1.02	.81	.75	1.10	1.08	1.10
Average for year	1.90	1.56	1.30	1.18	.90	.85	1.28	1.18	1.10

Posted price per barrel of petroleum at wells in 1938, by grades, with dates of change

Date	Pennsylvania grade		Corning grade in Buckeye Pipe Line Co.[3]	Western Kentucky[3]	Illinois and Princeton, Ind.,[3]	Illinois Basin[4]	Midland, Mich.[4]	Oklahoma-Kansas[5]	
	Bradford and Allegany districts[1]	In Southwest Pennsylvania pipe lines[2]						34°-34.9°	36°-36.9°
Jan. 1	$2.20	$1.88	$1.27	$1.40	$1.35	$1.35	$1.27	$1.18	$1.22
Jan. 5							1.12		
Mar. 7	2.05	1.71							
June 13	1.80	1.46							
June 16			1.17						
June 22				1.30					
Sept. 1	1.68	1.34							
Sept. 27				1.20	1.25				
Sept. 29						1.25			
Oct. 2							[6] 1.025		
Oct. 12								.98	1.02
Oct. 13				1.10	1.05	1.15			
Oct. 14							[6] .925		
	1.90	1.56	1.22	1.30	1.23	1.30	1.08	1.14	1.18

Date	Panhandle, Texas (Carson and Hutchinson Counties, 35°-35.9°)[5]	West Texas 30°-30.9°[5]	Hobbs, N. Mex.[5]	Darst, Tex.[5]	Southwest Texas, Duval County, 22°-22.9°[5]	Van, Texas, 34°-34.9°[4]	East Texas[5]	Gulf Coast		
								Conroe, Tex., 38°-38.9°[5]	30°-30.9°[5]	20°-20.9°[5]
Jan. 1	$0.93	$0.88	$0.88	$1.09	$1.00	$1.02	$1.35	$1.40	$1.21	$0.96
Apr. 1										.95
Aug. 30							1.25			
Oct. 12	.81	.75	.75	.96	.83		1.10	[7] 1.27	1.08	.82
Oct. 13						.93				
	.90	.85	.85	1.06	.96	1.00	1.28	1.37	1.18	.92

Date	Rodessa, La., 36°-36.9°[8]	Smackover, Ark.[8]	Salt Creek, Wyo., 36°-36.9°[9]	Kevin-Sunburst, Mont.[3]	California[10]				
					Kettleman Hills, 38°-38.9°	Long Beach, 27°-27.9°	Midway-Sunset, 19°-19.9°	Playa del Rey, 22°-22.9°	Santa Fe Springs, 33°-33.9°
Jan 1	$1.17	$0.90	$1.22	$1.20	$1.39	$1.10	$0.74	$0.98	$1.20
Sept. 15		.75							
Oct. 5	.97	.73							
Oct. 11			1.02						
	1.12	.85	1.18	1.20	1.39	1.10	.74	.98	1.20

[1] The Tide-Water Pipe Co., Ltd.
[2] The Joseph Seep Purchasing Agency.
[3] The Ohio Oil Co.
[4] The Pure Oil Co.
[5] The Texas Co.
[6] Porter and Greendale districts.
[7] Gravity basis discontinued.
[8] Standard Oil Co. of Louisiana.
[9] Stanolind Oil & Gas Co.
[10] Standard Oil Co. of California.

Value of crude petroleum at wells in the United States, 1936–37, by States [1]

State	1936		1937	
	Total (thousands of dollars)	Average per barrel	Total (thousands of dollars)	Average per barrel
Arkansas	8,160	$0.78	11,400	$0.97
California	215,900	1.01	242,100	1.02
Colorado	1,660	1.01	1,800	1.12
Illinois	5,390	1.20	9,970	1.33
Indiana	1,010	1.23	1,140	1.35
Kansas	65,900	1.13	88,100	1.25
Kentucky	7,240	1.29	7,680	1.40
Louisiana:				
Gulf Coast	56,700	1.06	75,800	1.22
Northern	28,900	1.07	34,500	1.19
Total Louisiana	85,600	1.06	110,300	1.21
Michigan	15,950	1.34	21,950	1.32
Montana	7,700	1.31	7,300	1.26
New Mexico	22,930	.84	36,600	.94
New York	11,380	2.44	14,140	2.58
Ohio	6,090	1.58	5,820	1.64
Oklahoma	232,100	1.12	283,500	1.24
Pennsylvania	41,450	2.43	49,300	2.57
Texas:				
Gulf Coast	98,400	1.13	139,600	1.22
East Texas proper	190,900	1.14	223,700	1.31
West Texas	52,300	.84	71,800	.95
Rest of State	107,800	.97	159,400	1.07
Total Texas	449,400	1.05	594,500	1.16
West Virginia	8,200	2.13	8,800	2.29
Wyoming	13,700	.94	18,860	.98
Other States [2]	60	.95	80	1.04
Total United States	1,199,820	1.09	1,513,340	1.18

[1] Figures for 1938 not yet available.
[2] Missouri, Tennessee, and Utah.

ROYALTIES ON INDIAN AND FEDERAL LANDS

On page 853 of Minerals Yearbook 1938 were given data up to 1937 on royalty receipts, bonuses, etc., pertaining to Indian and Federal lands. The acreage of new leases on Indian lands during the fiscal year 1938 was 99,187 compared with 155,503 (revised) in 1937. Bonuses from the sale of leases in 1938 were $239,293, royalty from production of oil and gas totaled $5,048,280, and advance royalty and annual rentals amounted to $502,664.

The production of crude petroleum on Government lands in the calendar year 1938 totaled 43,515,000 barrels, of which 5,369,000 barrels valued at $5,869,000 was royalty.

REFINED PRODUCTS

Despite the general set-back in business conditions in 1938, petroleum refining was not affected nearly as much statistically as were many other industries. Domestic motor-fuel demand made a new record of 521,657,000 barrels, exceeding the 1937 demand by one-half of 1 percent, while the export demand increased 31 percent, making an increase of 2.5 percent in total motor-fuel demand.

Crude runs to stills dropped from 1,183,440,000 barrels in 1937 to 1,165,015,000 in 1938. Domestic demand for gas oil and distillate fuel oils was about the same as for 1937, and the demand for residual fuel oils declined from 325,514,000 barrels to 292,650,000. The demand for kerosene and asphalt increased slightly, but the demand for lubricants, wax, coke, and road oil was less than for 1937.

Comparative analyses of statistics for the major refined products, 1934–38

[Thousands of barrels, except as otherwise indicated]

	1934	1935	1936	1937	1938[1]
Motor fuel:					
Production	423,801	468,021	516,266	571,727	567,905
Imports	1	----------	78	144	79
Exports	24,686	30,613	28,646	38,306	50,198
Stocks, end of period	51,747	54,345	60,437	74,650	70,779
Domestic demand	407,106	434,810	481,606	519,352	521,657
Kerosene:					
Production	53,855	55,813	56,082	65,308	64,580
Exports	9,781	6,651	6,936	8,886	7,513
Stocks, end of period	6,398	7,915	5,633	7,083	7,799
Domestic demand	44,234	47,645	51,428	54,972	56,351
Gas oil and distillate fuel oils:					
Production	94,972	100,235	125,906	146,706	151,774
Imports	(2)	15	182	17	----------
Exports	(2)	16,249	20,448	30,129	29,903
Stocks, end of period	21,957	19,930	22,813	22,566	27,873
Domestic demand	(2)	86,028	102,757	116,841	116,564
Residual fuel oils:					
Production	240,381	259,826	287,968	312,064	294,972
Transfers [3]	8,382	13,067	15,732	17,423	10,660
Imports	(2)	16,115	18,801	22,114	20,985
Exports	(2)	12,699	14,435	15,304	17,728
Stocks, end of period	[4] 88,440	[4] 84,054	[4] 84,236	[4] 95,019 [5] 81,507	97,746
Domestic demand	(2)	280,695	307,884	325,514	292,650
Lubricants:					
Production	26,373	27,853	30,927	35,321	30,826
Imports	2	1	4	7	7
Exports	7,660	8,499	8,691	10,975	9,402
Stocks, end of period	7,331	7,025	6,942 [5] 6,482	7,512	7,695
Domestic demand	18,484	19,661	22,323	23,323	21,248
Wax (thousands of pounds):					
Production	468,720	450,240	472,920	521,640	435,400
Imports	37,292	19,557	16,669	36,929	28,927
Exports	198,958	229,905	187,342	231,723	201,919
Stocks, end of period	136,136	114,675	115,434	144,992	129,340
Domestic demand	240,035	261,353	301,488	297,288	278,060
Coke (thousands of short tons):					
Production	1,300.0	1,458.0	1,378.2	1,306.6	1,602.2
Exports	114.3	133.5	124.6	164.3	155.6
Stocks, end of period	405.1	388.9	389.4	378.6	707.5
Domestic demand	1,508.1	1,340.7	1,253.1	1,153.1	1,117.7
Asphalt (thousands of short tons):					
Production	2,840.5	3,115.1	3,868.8	4,182.0	4,392.4
Imports	15.6	54.0	21.6	34.1	33.2
Exports	239.9	232.8	211.4	45.5	50.2
Stocks, end of period	339.2	429.7	364.2	557.4 [5] 566.1	480.9
Domestic demand	2,536.5	2,845.8	3,744.5	3,977.4	4,460.6
Road oil:					
Production	6,210	6,030	7,398	8,087	7,788
Stocks, end of period	664	732	851	984 [5] 667	680
Domestic demand	6,378	5,962	7,279	7,954	7,775
Other finished products:					
Production	1,872	1,888	2,148	2,382	1,921
Imports	316	150	----------	----------	----------
Exports	47	76	71	101	112
Stocks, end of period	231	220	198	230	263
Domestic demand	2,126	1,973	2,099	2,249	1,776

[1] Subject to revision.
[2] Figures not available.
[3] Net transfers from crude oil to fuel oil in California.
[4] California heavy crude included.
[5] For comparison with succeeding year.

The yield of gasoline reversed its downward trend to increase from 43.9 percent in 1937 to 44.3 in 1938. The yield of gas oil and distillate fuel oils also increased from 12.4 to 13.0, percent while that of the residual fuel oils decreased from 26.4 to 25.3 percent. (See fig. 6.)

Natural-gasoline production increased from about 49 million barrels in 1937 to about 50 million in 1938, but benzol production declined from 2,790,000 barrels in 1937 to 1,699,000 in 1938.

The total refinery output of gasoline in 1938 was about 556 million barrels, comprising about 245 million barrels of straight-run gasoline, 271 million barrels of cracked gasoline, and 40 million barrels of natural gasoline.

Runs to stills and production at refineries of the various refined products, 1934–38

[Thousands of barrels, except as otherwise indicated]

	1934	1935	1936	1937	1938 [1]
Input:					
Crude petroleum:					
Domestic	860,776	933,659	1,034,637	1,157,444	1,138,828
Foreign	34,860	32,131	33,933	25,996	26,187
Total crude petroleum	895,636	965,790	1,068,570	1,183,440	1,165,015
Natural gasoline [2]	28,162	31,025	33,817	39,381	39,961
Total input	923,798	996,815	1,102,387	1,222,821	1,204,976
Output:					
Gasoline	416,932	457,842	504,811	559,141	555,850
Kerosene	53,855	55,813	56,082	65,308	64,580
Gas oil and distillate fuel oils	94,972	100,235	125,906	146,706	151,774
Residual fuel oils	240,381	259,826	287,968	312,064	294,972
Lubricants	26,373	27,853	30,927	35,321	30,826
Wax	1,674	1,608	1,689	1,863	1,555
Coke	6,500	7,290	6,891	6,533	8,011
Asphalt	15,623	17,133	21,278	23,001	24,159
Still gas	44,391	51,184	57,046	64,218	62,410
Wax thousands of pounds	468,720	450,240	472,920	521,640	435,400
Coke thousands of short tons	1,300.0	1,458.0	1,378.2	1,306.6	1,602.2
Asphalt do	2,840.5	3,115.1	3,868.8	4,182.0	4,392.4
Still gas millions of cubic feet	169,479	197,220	226,466	241,981	236,943
Road oil	6,210	6,030	7,398	8,087	7,788
Other finished products	1,872	1,888	2,148	2,382	1,921
Crude gasoline (net)	[3] 3,007	1,032	486	[3] 128	[3] 1,616
Other unfinished oils (net)	1,949	[3] 2,412	[3] 8,962	[3] 7,931	[3] 4,450
Shortage	16,073	11,493	8,719	6,256	7,196
Total output	923,798	996,815	1,102,387	1,222,821	1,204,976

[1] Subject to revision.
[2] Includes natural gasoline run through pipe lines in California.
[3] Negative quantity; represents net excess of unfinished oils rerun over unfinished oils produced.

These statistics, however, do not give a true picture of the distress brought to the industry by the recession. Domestic motor-fuel demand was halted in its upward sweep of early 1937, in the first 4 months of which it was more than 11 percent higher than for the same period in 1936. In contrast, the increase in the demand for the first half of 1938 was less than one-half of 1 percent over the demand for the same period of 1937. The inability of the industry to adjust its operations to the sudden change from the rapid upward trend to the retarded demand caused a large accumulation of stocks. Finished and unfinished gasoline inventories reached a peak of more than 92 million barrels, or 57 day's supply on March 31, 1938, compared with 82 million barrels or 51 day's supply on the same date in 1937. Stocks of residual fuel oil increased from 78 million to 87 million barrels and distillate fuel oil stocks from 17 million to 19 million barrels during this same period.

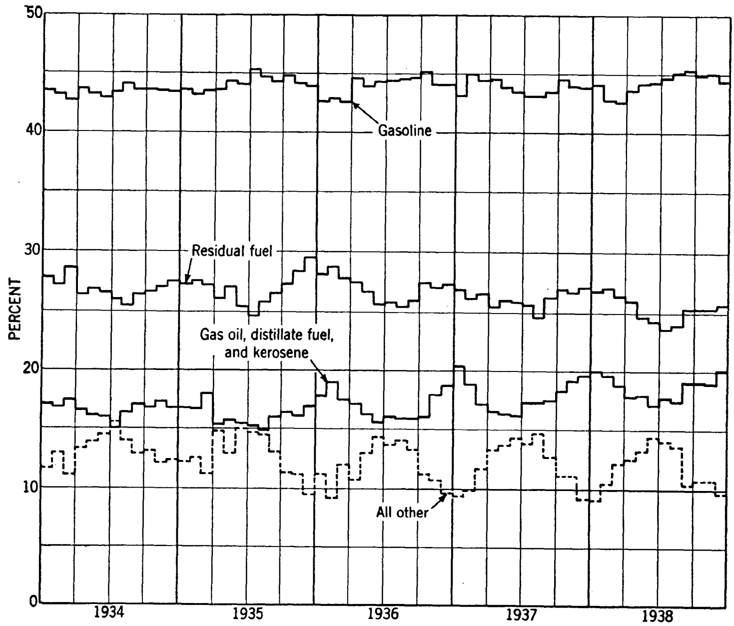

FIGURE 6.—Yields of principal petroleum products from crude oil run to stills, 1934–38, by months.

Prices dropped sharply. The refinery price for Oklahoma gasoline fell from a high of 6.19 cents per gallon in May 1937 to 4.90 cents in May 1938. (See fig. 7.) This represented a loss of more than 20 per-

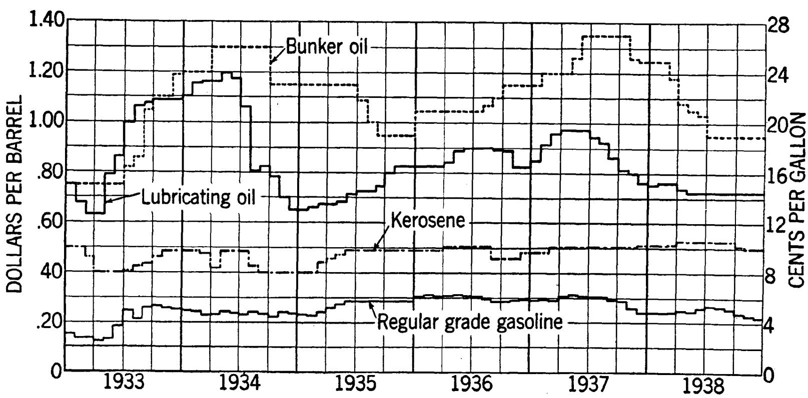

FIGURE 7.—Prices of refined petroleum products, 1933–38, by months.

cent for the year, whereas the Bureau of Labor Statistics index of wholesale prices of all commodities decreased only 11 percent during this period. Heavy fuel-oil prices dropped nearly 10 cents per barrel between the summer of 1937 and August 1938, while the prices of most lubricating oils declined.

Runs to stills and production at refineries in the United States of the various refined products, 1937–38, by months

[Thousands of barrels, except as otherwise indicated]

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1937													
Input:													
Crude petroleum [1]	94, 179	84, 984	94, 400	93, 573	100, 452	99, 323	104, 783	105, 251	103, 494	105, 023	99, 615	98, 363	1, 183, 440
Natural gasoline [2]	3, 003	2, 516	2, 570	2, 695	2, 642	2, 571	2, 981	3, 557	4, 490	4, 377	4, 088	3, 891	39, 381
Total input	97, 182	87, 500	96, 970	96, 268	103, 094	101, 894	107, 764	108, 808	107, 984	109, 400	103, 703	102, 254	1, 222, 821
Fresh cracking stocks charged to stills:													
Crude oil	8, 591	9, 213	10, 269	10, 387	10, 563	10, 601	11, 876	12, 204	11, 868	10, 871	11, 598	12, 552	130, 593
Other oils	44, 513	39, 398	44, 014	42, 264	45, 982	44, 249	46, 154	46, 603	45, 507	47, 263	44, 064	44, 045	534, 056
Output:													
Gasoline	43, 630	40, 782	44, 621	44, 475	46, 769	45, 748	48, 271	49, 002	49, 683	51, 223	47, 873	47, 064	559, 141
Kerosene	5, 923	4, 866	5, 187	4, 907	5, 343	5, 087	5, 482	5, 726	5, 371	5, 731	5, 876	5, 809	65, 308
Gas oil and distillate fuel oils	13, 319	11, 206	11, 005	10, 674	11, 158	11, 088	12, 654	12, 558	12, 681	13, 585	13, 215	13, 563	146, 706
Residual fuel oil	25, 623	22, 302	25, 191	24, 100	26, 587	26, 033	26, 958	26, 026	27, 094	28, 425	26, 687	27, 038	312, 064
Lubricants	2, 649	2, 728	2, 873	3, 048	3, 141	2, 978	2, 980	2, 900	2, 920	3, 215	2, 953	2, 936	35, 321
Wax	149	149	149	156	170	147	156	150	150	158	175	154	1, 863
Coke	511	458	536	509	548	498	548	565	567	635	556	602	6, 533
Asphalt	1, 200	978	1, 509	1, 751	2, 189	2, 454	2, 570	2, 780	2, 575	2, 159	1, 734	1, 102	23, 001
Still gas	4, 864	4, 614	5, 253	5, 293	5, 789	5, 576	5, 778	5, 869	5, 574	5, 453	5, 081	5, 074	64, 218
Wax ....thousands of pounds	41, 720	41, 720	41, 720	43, 680	47, 600	41, 160	43, 680	42, 000	42, 000	44, 240	49, 000	43, 120	521, 640
Coke ....thousands of short tons	102. 2	91. 6	107. 2	101. 8	109. 6	99. 6	109. 6	113. 0	113. 4	127. 0	111. 2	120. 4	1, 306. 6
Asphalt ....do	218. 2	177. 8	274. 4	318. 5	398. 0	446. 2	467. 2	505. 4	468. 1	392. 6	315. 3	200. 3	4, 182. 0
Still gas ....millions of cubic feet	18, 716	17, 544	19, 941	19, 917	21, 585	20, 709	21, 301	21, 820	20, 697	20, 581	19, 538	19, 632	241, 981
Road oil	189	217	217	408	799	1, 413	1, 474	1, 529	791	517	298	235	8, 087
Other finished products	175	185	247	192	196	199	222	188	227	228	136	187	2, 382
Crude gasoline (net)	311	[3] 163	520	[3] 232	160	36	[3] 55	[3] 46	[3] 160	[3] 536	[3] 71	108	[3] 128
Other unfinished oils (net)	[3] 1, 870	[3] 982	[3] 781	603	[3] 66	[3] 96	[3] 161	827	[3] 241	[3] 2, 043	[3] 1, 265	[3] 1, 856	[3] 7, 931
Shortage	509	160	443	384	311	733	887	734	752	650	455	238	6, 256
Total output	97, 182	87, 500	96, 970	96, 268	103, 094	101, 894	107, 764	108, 808	107, 984	109, 400	103, 703	102, 254	1, 222, 821

1938 [4]													
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
Fresh cracking stocks charged to stills:													
Crude oil	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	43,944	38,824	42,576	43,642	45,880	45,571	48,009	48,660	46,860	46,792	44,674	44,961	540,393
Output:													
Gasoline	46,755	40,469	44,116	44,582	46,645	44,247	47,607	48,662	47,312	49,677	47,998	47,780	555,850
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	26,204	23,866	25,328	24,833	24,392	22,761	23,547	24,232	24,552	25,487	24,573	25,197	294,972
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	1,187	1,054	1,534	1,837	2,475	2,451	2,617	2,829	2,510	2,557	1,775	1,333	24,159
Still gas	4,937	4,428	4,901	5,073	5,542	5,387	5,730	5,753	5,287	5,356	5,083	4,933	62,410
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	215.8	191.6	278.9	334.0	450.0	445.6	475.8	514.4	456.3	464.9	322.7	242.4	4,392.4
Still gas — millions of cubic feet	18,968	16,950	18,476	19,128	20,801	20,197	21,277	21,780	20,052	20,629	19,727	18,958	236,943
Road oil	157	158	265	435	660	1,286	1,418	1,477	964	572	202	194	7,788
Other finished products	150	157	201	167	187	160	160	142	137	152	143	165	1,921
Crude gasoline (net)	[3] 434	503	23	90	[3] 215	[3] 354	[3] 352	[3] 245	[3] 440	[3] 188	[3] 283	279	[3] 1,616
Other unfinished oils (net)	[3] 1,212	[3] 615	615	414	442	728	372	[3] 271	[3] 2,236	[3] 1,785	[3] 28	[3] 874	[3] 4,450
Shortage	634	374	634	800	689	632	688	667	512	735	423	408	7,196
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

[1] Details by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,374,000 barrels run through pipe lines in California in 1937 and 1,349,000 barrels in 1938.
[3] Negative quantity; represents net excess rerun over production.
[4] Subject to revision.

Runs to stills and production at refineries in the United States of the various refined products, 1937–38, 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
1937											
Input:											
Crude petroleum [1]	198,080	40,286	164,243	121,238	75,415	282,014	50,742	24,912	23,365	203,145	1,183,440
Natural gasoline [2]	1,540	362	4,077	5,895	5,816	6,730	835	731	826	12,569	39,381
Total input	199,620	40,648	168,320	127,133	81,231	288,744	51,577	25,643	24,191	215,714	1,222,821
Fresh cracking stocks charged to stills:											
Crude oil	31,778	378	12,886	860	2,132	67,657	10,456	2,706	1,740		130,593
Other oils	89,614	15,655	103,451	62,655	33,574	112,817	23,306	7,504	9,761	75,719	534,056
Output:											
Gasoline	81,096	19,939	95,409	69,576	44,391	125,888	18,241	11,170	13,464	79,967	559,141
Kerosene	11,024	3,220	6,238	7,396	3,515	20,351	5,927	1,787	796	5,054	65,308
Gas oil and distillate fuel oils	30,020	2,756	17,033	11,434	5,423	39,385	7,800	2,428	1,462	28,965	146,706
Residual fuel oils	55,274	4,315	24,953	21,819	20,914	73,223	13,212	6,215	4,439	87,700	312,064
Lubricants	9,360	6,083	3,457	3,659	229	7,929	1,246	467	305	2,586	35,321
Wax	892	312	154	120	12	188	100	6	79		1,863
Coke	52	122	3,634	1,181	531	564	83	10	354	2	6,533
Asphalt	9,155	563	3,920	1,475	612	1,246	1,254	896	697	3,183	23,001
Still gas	10,339	2,301	12,377	6,968	3,537	17,893	1,993	899	1,344	6,567	64,218
Wax ... thousands of pounds	249,760	87,360	43,120	33,600	3,360	52,640	28,000	1,680	22,120		521,640
Coke ... thousands of short tons	10.4	24.4	726.8	236.2	106.2	112.8	16.6	2.0	70.8	.4	1,306.6
Asphalt ... do	1,664.5	102.4	712.7	268.1	111.2	226.6	228.0	162.9	126.8	578.8	4,182.0
Still gas ... millions of cubic feet	31,835	8,836	46,710	26,721	15,990	70,240	7,413	3,894	5,106	25,236	241,981
Road oil	903	49	1,854	688	3	293	126	371	1,111	2,689	8,087
Other finished products	768	248	398	152	168	296	40	10	117	185	2,382
Crude gasoline (net)	[3] 369	[3] 42	[3] 1,274	1,292	122	255	[3] 230	6	3	109	[3] 128
Other unfinished oils (net)	[3] 7,889	[3] 46	865	[3] 412	289	[3] 577	1,000	624	[3] 473	[3] 1,312	[3] 7,931
Shortage	[4] 1,005	828	[4] 698	1,785	1,485	1,810	785	754	493	19	6,256
Total output	199,620	40,648	168,320	127,133	81,231	288,744	51,577	25,643	24,191	215,714	1,222,821

1938[5]											
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
Fresh cracking stocks charged to stills:											
Crude oil	22,843	5,268	19,188	2,814	2,169	76,446	7,975	1,563	1,960	5,531	145,757
Other oils	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	17,044	10,775	13,919	77,528	555,850
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	50,722	4,725	23,319	19,101	15,871	73,774	10,806	5,697	4,916	86,041	294,972
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	9,534	653	3,703	1,599	1,499	1,193	1,355	941	538	3,144	24,159
Still gas	9,188	2,187	12,244	5,775	2,999	19,039	2,290	552	1,227	6,909	62,410
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	1,602.2
Asphalt .... do	1,733.4	118.7	673.3	290.7	272.4	217.1	246.5	170.9	97.8	571.6	4,392.4
Still gas .... millions of cubic feet	27,662	8,232	46,797	21,935	13,881	76,150	9,176	2,505	4,973	25,632	236,943
Road oil	331	140	1,750	830	1	235	15	417	1,238	2,831	7,788
Other finished products	790	170	295	120	58	104	47	1	97	239	1,921
Crude gasoline (net)	[3] 94	[3] 8	[3] 952	386	[3] 83	[3] 590	[3] 372	[3] 6	2	101	[3] 1,616
Other unfinished oils (net)	[3] 6,897	[3] 45	258	[3] 986	853	543	462	687	78	597	[3] 4,450
Shortage	[4] 1,418	873	[4] 604	2,108	1,657	1,574	681	823	505	997	7,196
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

[1] Details by districts and months in section on "Consumption and distribution of crude petroleum."
[2] Includes 1,374,000 barrels run through pipe lines in California in 1937 and 1,349,000 barrels in 1938.
[3] Negative quantity; represents net excess rerun over production.
[4] Negative quantity.
[5] Subject to revision.

Stocks of refined products in the United States, 1937–38, by months

[Thousands of barrels, except as otherwise indicated]

	Jan. 1[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
1937													
Gasoline	56, 382	64, 293	71, 453	74, 171	73, 419	72, 396	67, 839	62, 956	59, 413	58, 037	61, 141	63, 728	69, 892
Kerosene	5, 633	5, 622	5, 443	5, 396	5, 047	5, 576	6, 781	7, 553	8, 637	8, 839	8, 877	8, 357	7, 083
Gas oil and distillate fuel oil	22, 813	19, 088	18, 211	16, 724	16, 889	18, 451	20, 657	23, 637	25, 952	27, 020	28, 101	26, 852	22, 566
Residual fuel oils	84, 236	83, 406	80, 571	78, 435	77, 318	79, 158	81, 224	84, 154	86, 420	89, 007	92, 182	93, 225	95, 019
Lubricants	6, 482	6, 788	7, 115	6, 771	6, 556	6, 478	6, 447	6, 566	6, 426	6, 542	6, 789	6, 907	7, 512
Wax	412	399	403	386	368	379	377	390	415	441	461	499	518
Coke	1, 947	1, 921	1, 898	2, 016	2, 058	1, 996	1, 952	1, 901	1, 878	1, 802	1, 646	1, 831	1, 893
Asphalt	2, 003	2, 441	2, 445	2, 730	2, 905	3, 010	2, 870	2, 752	2, 910	2, 560	2, 521	2, 807	3, 066
Wax thousands of pounds	115, 434	111, 790	112, 862	108, 103	103, 175	106, 089	105, 676	109, 318	116, 231	123, 563	129, 095	139, 887	144, 992
Coke thousands of short tons	389. 4	384. 1	379. 7	403. 3	411. 7	399. 2	390. 5	380. 1	375. 5	360. 4	329. 2	366. 2	378. 6
Asphalt do	364. 2	443. 9	444. 6	496. 5	528. 3	547. 3	521. 9	500. 5	529. 1	465. 4	458. 3	510. 4	557. 4
Road oil	851	814	797	853	1, 030	1, 139	1, 207	1, 175	1, 156	973	961	945	984
Other finished products	198	210	201	195	204	197	185	197	199	200	219	206	230
Crude gasoline	6, 812	7, 123	6, 960	7, 480	7, 248	7, 408	7, 444	7, 389	7, 343	7, 343	6, 896	6, 900	7, 098
Other unfinished oils	38, 826	37, 412	36, 865	36, 746	37, 787	38, 555	39, 017	39, 570	41, 074	41, 229	39, 796	38, 853	37, 552
	226, 595	229, 517	232, 362	231, 903	230, 829	234, 743	236, 000	238, 240	241, 823	243, 993	249, 590	251, 110	253, 413
1938[2]													
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 distillate fuel oil	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	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, 114	3, 268	3, 412	3, 482	3, 650	3, 909	3, 681	3, 483	3, 115	2, 591	2, 432	2, 462	2, 645
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	566. 1	594. 2	620. 4	633. 2	663. 7	710. 7	669. 3	633. 2	566. 4	471. 1	442. 2	447. 6	480. 9
Road oil	667	673	663	797	1, 024	1, 091	1, 103	1, 052	948	814	680	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, 632	249, 107	255, 650	257, 226	261, 757	267, 585	266, 497	270, 046	268, 022	268, 124	269, 307	267, 372	259, 613

[1] For comparison with succeeding month.

[2] Subject to revision.

Summary of percentage yields of refined products in the United States, 1932–38

[Computed on total crude runs to stills]

Product	1932	1933	1934	1935	1936	1937	1938 [1]
Finished products:							
Gasoline [2]	44.7	43.7	43.4	44.2	44.1	43.9	44.3
Kerosene	5.3	5.7	6.0	5.8	5.2	5.5	5.5
Gas oil and distillate fuel oils	8.5	9.2	10.6	10.4	11.8	12.4	13.0
Residual fuel oils	27.5	27.6	26.8	26.9	27.0	26.4	25.3
Lubricants	2.7	2.8	2.9	2.9	2.9	3.0	2.6
Wax	.2	.2	.2	.2	.2	.2	.1
Coke	1.1	.9	.7	.7	.6	.6	.7
Asphalt	1.7	1.5	1.8	1.8	2.0	1.9	2.1
Road oil	.8	.6	.7	.6	.7	.7	.7
Still gas	5.0	5.2	5.0	5.3	5.3	5.4	5.4
Other	.2	.2	.2	.2	.2	.2	.2
Unfinished products:							
Gasoline	[3] .2	.5	[3] .3	.1	(4)	(3 4)	[3] .1
Other			.2	[3] .3	[3] .8	[3] .7	[3] .4
Shortage	2.5	1.9	1.8	1.2	.8	.5	.6
	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[1] Subject to revision.
[2] Based on total gasoline production less natural gasoline used.
[3] Negative percentage; represents excess percentage rerun over percentage produced.
[4] Less than 0.1 percent.

Comparative analyses of statistics for motor fuel in 1938, by months

[Thousands of barrels]

	1938 [1]						
	January	February	March	April	May	June	July
Production	47,681	41,762	45,352	46,025	48,159	45,718	48,913
Daily average	1,538	1,492	1,463	1,534	1,554	1,524	1,578
Imports	----	----	----	----	----	----	----
Exports [2]	3,090	3,931	3,562	4,474	4,576	4,284	4,277
Daily average	100	140	115	149	148	143	138
Stocks, end of period	84,065	90,035	90,566	88,863	87,535	80,676	77,838
Domestic demand	35,176	31,861	41,259	43,254	44,911	48,293	47,474
Daily average	1,135	1,138	1,331	1,442	1,449	1,610	1,531

	1938—Continued						1937 (total)
	August	September	October	November	December	Total	
Production	50,071	48,208	49,789	48,201	48,026	567,905	571,727
Daily average	1,615	1,607	1,606	1,607	1,549	1,556	1,566
Imports	----	79	----	----	----	79	144
Exports [2]	4,829	3,528	4,526	3,698	5,423	50,198	38,306
Daily average	156	118	146	123	175	138	105
Stocks, end of period	72,621	71,322	70,313	69,825	70,779	70,779	74,650
Domestic demand	50,459	46,058	46,272	44,991	41,649	521,657	519,352
Daily average	1,628	1,535	1,493	1,500	1,344	1,429	1,423

[1] Subject to revision.
[2] Includes benzol.

Although in 1936 and 1937 the number of refineries decreased, the total crude-oil capacity continued the upward trend, last interrupted in 1932. There were 551 completed plants on January 1, 1938, compared with 572 the previous year; the daily capacity of these plants rose from 4,294,881 barrels (old basis) on January 1, 1937, to 4,351,151 barrels (new basis) on January 1, 1938.

The operating ratio, or the percentage of crude runs to capacity, decreased from the relatively high figure of 83 for 1937 to 78 for 1938. The gain in total capacity of excess equipment in 1937 virtually silenced those who claimed that a shortage of some products was imminent, yet it was not enough to alarm those with contrary views. Although at the beginning of 1938 about 800,000 barrels of daily crude-oil capacity remained unused in the operating units besides about 250,000 barrels of idle equipment in "good shape" on that date, most of this is obsolete and constitutes little in the nature of a threat toward overrunning.

Summary of refinery capacity in the United States, January 1, 1934–38 [1]

Year	Number				Capacity (barrels per day)			
	Operating	Shut down	Building	Total	Operating	Shut down	Building	Total
1934	454	137	13	604	3,553,569	364,648	44,450	3,962,667
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

[1] For data on 1914–33 see Minerals Yearbook, 1938, p. 863.
[2] New basis; for complete information see Bureau of Mines Information Circular 7034.

MOTOR FUEL

Motor-fuel statistics for the year, with the exception of exports, did not differ greatly from those of 1937. Production and stocks at the end of the year were slightly less, and domestic demand was slightly

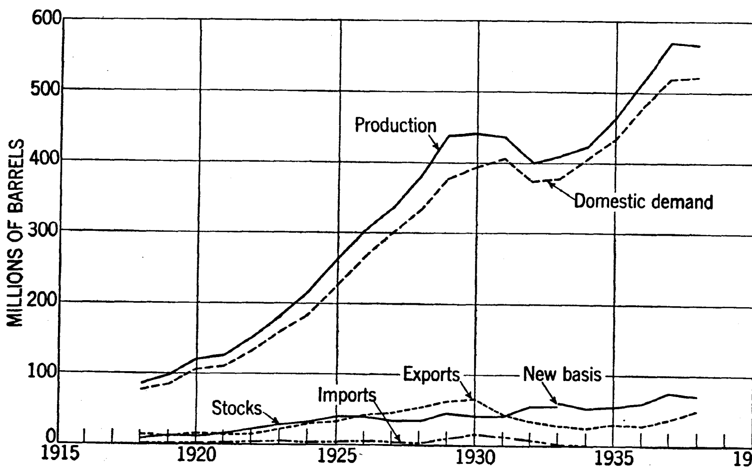

FIGURE 8.—Trends in production, domestic demand, exports, imports, and stocks of motor fuel, 1918–38.

more. Exports, however, showed an increase of 12 million barrels (31 percent). (See fig. 8.)

Demand.—The domestic motor-fuel demand in 1938 was 521,657,000 barrels, an increase of one-half of 1 percent over the 1937 record of 519,352,000 barrels. The demand for the first quarter increased 1.9 percent over that for the same quarter of the previous year, but in the months from April to September, inclusive, it was less than in the corresponding months of 1937, the July and September figures declining 3.4 and 2.5 percent, respectively. The recovery in business conditions during the fall gave the last quarter of 1938 an increase of 4¼ percent over the last quarter of 1937 and brought the year's demand above that of 1937.

Domestic demand for motor fuel per motor vehicle in use, 1936–38

	1936	1937	1938
Domestic demand for motor fuel .... barrels..	[1]478,874,000	[2] 519,352,000	521,657,000
Motor vehicles in use July 1 .... number..	25,805,900	[2] 27,571,700	28,190,300
Motor-fuel demand per motor vehicle in use:			
Actual .... barrels..	18.56	[2] 18.84	18.50
Based on 1924–31 trend [3] .... do....	20.17	20.84	21.51
Deviation from trend .... do....	—1.61	[2] —2.00	—3.01
Production and trade [4] .... index numbers..	88	91	77

[1] Natural-gasoline losses not included.
[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, 1936–38

[Thousands of barrels]

	1936	1937 [1]	1938 [2]
Passenger cars:			
Highway	150,896	161,302	161,390
City	170,128	182,614	185,963
Total passenger cars	321,024	343,916	347,353
Trucks:			
Highway	35,462	39,723	40,649
City	57,643	63,084	60,973
Total trucks	93,105	102,807	101,622
Busses	14,500	15,500	15,300
Total automotive demand [3]	428,629	462,223	464,275
Other demand	52,977	57,129	57,382
Grand total	481,606	519,352	521,657

[1] Revised figures. [2] Subject to revision. [3] 89 percent of total motor-fuel demand.

New motor-vehicle registrations in 1938 dropped to 2,256,000 compared with 4,102,000 in 1937. Preliminary calculations of cars in use on July 1 as shown in the accompanying table indicate an increase of approximately 618,000 vehicles to 28,190,000 compared with 27,572,000 for July 1, 1937. Gasoline consumption per motor vehicle in use was 18.50 barrels for 1938 compared with 18.84 barrels for 1937.

The export demand for gasoline increased from 38,306,000 barrels in 1937 to 50,198,000 in 1938. Part of these exports undoubtedly have been for the purpose of building up stocks for military purposes, but because of the secrecy involved it is difficult to estimate how much has gone into such storage. It is almost a certainty, considering the greater number of motor vehicles and improved highways in foreign countries, that part of this increase in exports represents a permanent increase in demand and will remain a future market for the United States if not supplied by other sources. More detailed information on exports and imports is given in another section of this chapter.

Production of gasoline in the United States in 1938, 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	2,599	2,315	2,555	2,450	2,460	2,469	2,369	2,628	2,589	2,664	2,520	2,452	30,070
Appalachian	768	694	588	672	673	637	725	718	705	713	734	744	8,371
Indiana, Illinois, Kentucky, etc	3,114	2,787	3,148	3,163	3,454	3,316	3,466	3,315	3,326	3,752	3,302	3,334	39,477
Oklahoma, Kansas, and Missouri	2,544	2,398	2,809	2,908	3,014	2,964	3,141	3,013	2,789	2,807	2,750	2,615	33,752
Texas Inland	1,929	1,666	1,737	1,759	1,734	1,734	1,923	1,712	1,744	1,610	1,720	1,523	20,791
Texas Gulf Coast	4,357	3,759	3,946	4,289	4,384	3,937	4,277	4,625	4,412	4,609	4,359	5,079	52,033
Louisiana Gulf Coast	659	615	591	584	679	685	792	879	858	765	953	743	8,803
Arkansas and Louisiana Inland	547	446	541	517	534	491	526	580	544	644	459	578	6,407
Rocky Mountain	606	565	615	524	605	572	657	722	655	633	612	594	7,360
California	3,628	3,022	3,239	3,174	3,267	2,930	3,144	3,332	3,312	3,186	2,988	3,132	38,354
Total straight run	20,751	18,267	19,769	20,040	20,804	19,735	21,020	21,524	20,934	21,383	20,397	20,794	245,418
Percent yield [1]	21.2	20.7	20.6	20.9	21.0	21.0	21.0	21.2	21.6	21.2	21.0	21.2	21.1
Cracked:													
East Coast	3,745	2,888	3,210	3,579	3,806	3,654	3,696	3,773	3,442	3,450	3,554	3,482	42,279
Appalachian	889	819	789	887	920	953	982	941	899	917	830	914	10,740
Indiana, Illinois, Kentucky, etc	4,183	3,808	4,011	3,973	4,234	4,100	4,408	4,472	4,575	4,568	4,754	4,460	51,546
Oklahoma, Kansas, and Missouri	2,165	1,895	1,910	2,263	2,364	2,194	2,309	2,406	2,248	2,208	2,021	2,212	26,195
Texas Inland	1,234	1,239	1,147	1,227	1,295	1,317	1,313	1,417	1,241	1,328	1,307	1,283	15,348
Texas Gulf Coast	6,755	5,703	6,673	6,398	6,917	6,405	7,119	7,425	6,865	7,393	7,112	6,802	81,567
Louisiana Gulf Coast	784	673	641	625	678	511	663	646	625	706	664	643	7,859
Arkansas and Louisiana Inland	323	274	287	290	314	264	285	315	275	343	335	326	3,631
Rocky Mountain	472	399	441	428	525	472	507	512	490	480	528	502	5,756
California	1,897	1,776	2,005	2,016	1,989	2,007	2,370	2,281	2,389	2,469	2,274	2,077	25,550
Total cracked	22,447	19,474	21,114	21,686	23,042	21,877	23,652	24,188	23,049	23,862	23,379	22,701	270,471
Percent yield [1]	22.9	22.1	22.0	22.7	23.2	23.3	23.7	23.9	23.7	23.7	24.0	23.2	23.2
Total production including natural gasoline:													
East Coast	6,481	5,290	5,875	6,089	6,312	6,189	6,120	6,481	6,167	6,246	6,208	6,089	73,547
Appalachian	1,685	1,536	1,396	1,575	1,610	1,608	1,729	1,685	1,627	1,653	1,590	1,686	19,380
Indiana, Illinois, Kentucky, etc	7,664	6,889	7,508	7,430	8,000	7,701	8,218	8,084	8,331	8,814	8,612	8,260	95,511
Oklahoma, Kansas, and Missouri	5,230	4,760	5,242	5,529	5,739	5,528	5,842	5,838	5,619	5,695	5,350	5,347	65,719
Texas Inland	3,716	3,483	3,410	3,480	3,564	3,562	3,713	3,604	3,487	3,568	3,727	3,450	42,764
Texas Gulf Coast	11,804	9,766	11,034	11,175	11,729	10,712	11,855	12,474	11,619	12,662	12,168	12,665	139,663
Louisiana Gulf Coast	1,494	1,330	1,287	1,246	1,381	1,211	1,472	1,549	1,514	1,491	1,652	1,417	17,044
Arkansas and Louisiana Inland	929	784	887	855	903	811	882	964	887	1,063	861	949	10,775
Rocky Mountain	1,166	1,043	1,132	1,002	1,161	1,067	1,196	1,266	1,203	1,213	1,260	1,210	13,919
California	6,586	5,588	6,345	6,201	6,246	5,858	6,580	6,717	6,858	7,272	6,570	6,707	77,528
Total United States: 1938	46,755	40,469	44,116	44,582	46,645	44,247	47,607	48,662	47,312	49,677	47,998	47,780	555,850
1937	43,630	40,782	44,621	44,475	46,769	45,748	48,271	49,002	[2] 49,683	[2] 51,223	47,873	47,064	[2] 559,141

[1] Based on crude runs to stills.
[2] Revised figures—straight run, Louisiana Gulf Coast, September revised to 892, October to 700, and total to 8,669 (Minerals Yearbook, 1938, p. 867).

Production.—Motor-fuel production was 3,822,000 barrels less than the 1937 figure of 571,727,000 barrels. The 1938 production of 567,905,000 barrels comprises 245,418,000 barrels of straight-run gasoline, 270,471,000 of cracked gasoline, 39,961,000 of blended natural gasoline, 10,356,000 of unblended natural gasoline, and 1,699,000 of benzol. The ratio of straight-run gasoline to total motor-fuel production continued its trend, dropping from 44.0 percent in 1937 to 43.2 in 1938, while that of cracked gasoline continued its increase, rising from 46.9 percent in 1937 to 47.6 in 1938. The ratio of natural gasoline increased from 8.6 percent in 1937 to 8.9 in 1938, while that of benzol declined from 0.5 to 0.3 percent. The decline of 39 percent in benzol production probably resulted from curtailing steel-mill operations, which dropped from an average of 61 percent of capacity in 1937 to 25 percent in 1938.

Yields.—The downward trend in gasoline yields was broken in 1938 when straight-run and cracked production comprised 44.3 percent of crude runs to stills compared with 43.9 percent in 1937. Almost one-half of this increase, however, represents a gain in production contributed by unfinished gasoline, stocks of which declined 1,616,000 barrels during the year.

The demand for increasingly better gasoline, both for automobiles and for airplanes, has put pressure on refiners to produce motor fuel with ever higher octane rating. Octane qualifications first appeared on October 19, 1931, when a 57–65 octane rating was required for regular-grade gasoline. This was changed on May 8, 1933, to 60–64 octane; on August 6, 1934, to 63–70 octane; on April 15, 1935, to 68–70 octane; and on April 20, 1937, to 67–69 octane. Army airplanes and many air-transport planes now require 100 octane fuel.

The two principal methods open to refiners for increasing the octane rating of their motor fuel are to add tetraethyl lead and to re-form. The loss by re-forming, or cracking, gasoline has been one of the most expensive losses, probably around 20 to 25 percent.

During recent years the polymerization process has been developing; it is somewhat the antithesis of cracking, whereby the lighter molecules, such as those of still gas and natural gas, are converted into heavier molecules to make gasoline. The principal source of charging stock for the polymerization units now in operation is the gas from the cracking stills. Although the quantity of gasoline produced by polymerization is extremely small, it has some influence toward raising gasoline yields.

Of importance for the future is the rapid development of new catalytic cracking processes, which increase the yield of the lighter products of petroleum considerably.

The yield of cracked gasoline continued its upward trend by increasing from 22.7 percent in 1937 to 23.2 in 1938, but the yield of straight-run gasoline remained virtually the same at 21.1 percent, 0.2 percent lower than in 1937.

During the early part of the year gasoline yields were low, dropping to 42.6 percent in March. From this point they rose steadily to 45.3 percent in September, a point that had not been exceeded since September 1933.

Among the districts, Inland Texas is noteworthy because of its continuous upward trend, the yield having increased approximately 6 percent in the last 3 years. The 1938 yield was 54.0 percent compared with 51.2 percent in 1937.

Prices.—The average refinery price per gallon of regular-grade Oklahoma gasoline for 1938 was 4.90 cents compared with 5.81 cents in 1937 and 5.95 in 1936. The price at the beginning of the year was 4.75 cents and rose to a peak of 5.38 cents during the summer, but subsequently declined to close the year at 4.38 cents.

The average service-station price of regular-grade gasoline (ex-tax), as compiled by the American Petroleum Institute, dropped from 14.58 cents per gallon in 1937 to 14.07 cents in 1938. The price on January 1—14.29 cents—was the highest of the year, from which it declined almost every month to reach a low of 13.32 cents on January 1, 1939.

The greatest change in price (3.5 cents) was in Salt Lake City, Utah, where the price slid from 18.5 cents on January 1, 1938, to 15.0 cents on January 1, 1939. Louisville, Ky., with a change of 2.3 cents—from 14.0 cents to 11.7—was next in magnitude, and New York City and Hartford, Conn., followed with changes of 2.0 cents each. The Atlantic Coast area, with an average price decline of 0.81 cents, suffered the heaviest slump. This group, however, includes Philadelphia, where the 1.5-cent price increase from 11.75 to 13.25 cents was the greatest of any city.

In general, the Rocky Mountain States had the highest gasoline prices with averages ex-tax, at the beginning and closing of the year, of 16.75 and 16.25 cents, respectively. Boise, Idaho, with a price of 25.5 cents per gallon, including 6 cents in taxes, had the highest price of any city on January 1 but dropped out of that position during the year. Spokane, Wash., and Helena, Mont., where gasoline sold for 24 cents per gallon, including 6 cents in taxes, had the highest prices at the end of the year, and New Orleans came next with a 23.5-cent price, including 10 cents in taxes.

Wichita, Kans., had the lowest-price gasoline at 14.1 cents per gallon, including 4 cents in taxes, which was effective the last half of the year. However, as a group, the North Atlantic Coast States had the lowest prices. The averages for this section at the beginning and the end of the year were respectively, 12.83 and 12.02 cents, extax. Springfield, Mass., and Providence, R. I., in this group, where gasoline sold for 15 cents per gallon, including 4 cents in taxes, had the next lowest price to Wichita.

The posted price, however, is not necessarily the price the customer pays for his gasoline, discounts of 1 to 3 cents per gallon being customary in many parts of the country. Several attempts have been made to stop price cutting. It was prohibited in the oil code of N. R. A. days. The Wisconsin State Department fixed minimum prices for gasoline in 1934, and Iowa and Pennsylvania passed price-posting laws in 1937, while a similar law was vetoed in Illinois. California, in the same year, not only amended her Unfair Practices Act and Unfair Trade Act to strengthen oil marketing, but also her Oil Substitution Act originally passed in 1931 and amended in 1933, to require the posting and maintenance of the actual selling price. New Jersey passed a price-posting law that became effective June 1, 1938, which is a companion to the law permitting resale-price maintenance contracts between the dealer and service-station operator.

Although the difficulty of obtaining convictions under these acts has raised some question as to their effectiveness, a recent favorable decision in the Superior Court in Los Angeles has been followed by a number of arrests in California. Reports indicate that the New Jersey law has improved the price situation in that State. A few convictions have been obtained, but the cases were not appealed, so there has been no real test of the law as yet.

The 50-city average dealer's net price—10.18 cents on January 1, 1938—declined steadily throughout the year. However, the average price of 9.56 cents on January 1, 1939, was only 0.62 cent lower than that at the beginning of the year. The yearly average was 10.43 cents compared with 10.53 cents for 1937.

The year 1938 was the first in which there was no change in gasoline taxes, with the possible exception of some local levies in the less important places. State taxes remained at an average of 4.44 cents per gallon throughout the year, and the 1-cent Federal tax was in effect throughout the year. In addition to these taxes, there were numerous municipal and county taxes.

During 1938 one State (Missouri) and the District of Columbia had a tax rate of 2 cents, 10 States a tax rate of 3 cents, 18 States a tax rate of 4 cents, 10 States a tax rate of 5 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.

Average monthly prices of gasoline, 1937–38, in cents per gallon

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1937													
68–70 octane [1] at refineries in Oklahoma [2]	5.75	5.94	5.84	6.13	6.19	6.16	6.06	6.06	5.91	5.69	5.10	4.86	5.81
Dealer's net at 50 cities [3]	10.21	10.32	10.55	10.63	10.64	10.66	10.51	10.66	10.66	10.63	10.58	10.30	10.53
Service-station at 50 cities (including tax) [3]	18.47	18.47	18.83	19.07	19.16	19.13	19.12	19.21	19.16	19.25	19.12	18.85	18.99
1938													
67–69 octane at refineries in Oklahoma [2]	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 [3]	10.18	10.16	10.09	10.22	10.17	10.14	10.13	10.18	10.05	9.82	9.70	9.67	10.43
Service-station at 50 cities (including tax) [3]	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

[1] Changed to 67–69 octane Sept. 20.
[2] National Petroleum News.
[3] American Petroleum Institute.

Price differentials for 60–64 octane gasoline at New York and on the Gulf coast, 1937–38,[1] in cents per gallon

	Price on Gulf coast	Tanker rate, Gulf coast to New York	Cost at New York	Price at New York	Differential between price and cost at New York
Average 1937	5.99	0.94	6.93	6.88	−0.05
Average 1938	5.02	.51	5.53	6.19	+.66
December 1938	4.50	.67	5.17	5.88	+.71

[1] National Petroleum News.

Stocks.—Finished gasoline stocks totaled 65,949,000 barrels on December 31, 1938, 3,943,000 barrels less than on December 31, 1937. None of the districts had greater stocks than at the close of 1937. The largest decrease was in the East Coast district, which declined 1,024,000 barrels compared with an increase of 4,000,000 barrels in 1937.

Stocks of gasoline began to increase abnormally fast late in 1937 and reached a record peak at the end of March 1938 when stocks, including 7,285,000 barrels of unfinished gasoline, amounted to 92,320,000 barrels. Although crude runs to stills were greater than was considered desirable, they were restricted enough to reduce stocks almost to a normal level by the end of the year. Referring to the table of days' supply of motor fuel on hand it may be seen that the peak stocks at the end of March 1938 were 5.3 days' supply more of finished gasoline than those for March 31, 1937. As the year progressed, however, days' supply of gasoline approached nearer normal,

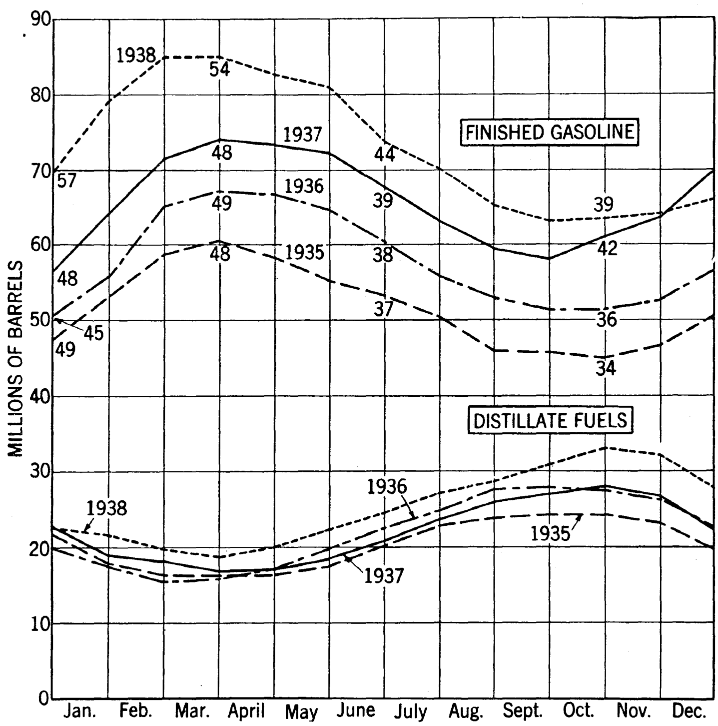

FIGURE 9.—Stocks of finished gasoline and distillate fuels, 1935–38, by months.

until on December 31, it was less than 2 days more than on December 31, 1936 and over 7 days less than on December 31, 1937.

Seasonal variations in gasoline stocks in recent years are shown in figure 9, which gives the quantity of finished gasoline stocks in millions of barrels for the last day of each month from December 1934 to December 1938, together with equivalent days' supply at certain periods. 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; they are the same as shown in the accompanying table.

Figure 9 also includes stocks of distillate fuels for the same period to bring out the contrast in seasonal variations in stocks of the two products. It may be seen that distillate fuel stocks were materially higher in 1938 than in the 3 previous years, particularly in October, November, and December.

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Stocks of gasoline in the United States in 1938, 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	7,437	8,161	8,997	8,519	7,802	7,294	6,248	6,150	5,684	4,804	4,841	5,192
Appalachian	1,649	1,882	1,752	1,666	1,475	1,313	1,318	1,141	1,043	1,034	1,064	1,252
Indiana, Illinois, Kentucky, etc	9,461	11,159	11,701	11,031	9,898	8,540	7,894	6,472	6,212	5,660	5,642	6,286
Oklahoma, Kansas, and Missouri	4,792	5,219	4,722	5,024	5,018	4,315	3,898	3,603	3,504	3,666	3,651	3,913
Texas Inland	2,373	2,686	2,657	2,575	2,518	2,126	2,007	1,836	1,567	1,649	1,848	1,857
Texas Gulf Coast	11,373	12,683	12,536	12,050	11,124	8,910	8,322	8,800	8,807	9,183	8,586	9,419
Louisiana Gulf Coast	1,545	1,470	1,485	1,372	1,548	1,586	1,604	1,360	1,216	1,142	1,277	1,239
Arkansas and Louisiana Inland	545	527	523	592	528	426	432	420	400	412	354	399
Rocky Mountain	2,165	2,532	2,549	2,493	2,531	2,180	1,810	1,410	1,232	1,203	1,306	1,435
California	11,879	12,626	13,121	12,338	11,568	10,469	9,558	8,945	9,154	9,986	10,807	10,813
Total United States	53,219	58,945	60,043	57,660	54,010	47,159	43,091	40,137	38,819	38,739	39,376	41,805
Bulk terminal and pipe line:												
East Coast	12,911	13,043	13,060	13,205	14,524	14,158	14,374	12,566	12,393	11,995	12,163	11,405
Appalachian	1,803	1,908	1,767	1,714	1,848	1,788	1,851	1,860	1,819	1,826	1,788	1,742
Indiana, Illinois, Kentucky, etc	4,566	4,227	3,436	3,585	4,284	4,412	4,708	4,317	4,383	5,177	5,275	5,247
Oklahoma, Kansas, and Missouri	2,573	2,878	2,772	2,817	2,594	2,444	2,361	2,243	2,190	2,139	2,299	2,339
Texas Inland	90	122	117	98	69	98	83	69	92	134	86	54
Texas Gulf Coast	556	632	738	501	368	317	363	322	294	313	269	207
Louisiana Gulf Coast	695	599	636	636	724	677	612	507	530	550	555	604
Arkansas and Louisiana Inland	138	155	140	126	157	166	196	155	126	140	174	167
California	2,563	2,509	2,326	2,342	2,409	2,506	2,585	2,423	2,517	2,529	2,098	2,379
Total United States	25,895	26,073	24,992	25,024	26,977	26,566	27,133	24,462	24,344	24,803	24,707	24,144
Unfinished gasoline:												
East Coast	991	1,166	1,192	1,285	1,139	1,110	1,139	1,110	1,083	1,062	980	1,000
Appalachian	242	256	269	265	306	308	271	279	294	242	241	239
Indiana, Illinois, Kentucky, etc	969	952	835	861	865	750	707	711	599	537	492	586
Oklahoma, Kansas, and Missouri	605	734	758	590	497	436	420	420	384	414	420	381
Texas Inland	290	297	273	278	260	274	282	281	265	255	261	250
Texas Gulf Coast	1,761	1,867	1,814	1,926	1,884	1,904	1,868	1,871	1,666	1,513	1,403	1,413
Louisiana Gulf Coast	583	441	541	580	633	573	519	412	372	413	335	391
Arkansas and Louisiana Inland	39	47	21	31	36	27	31	33	30	32	29	30
Rocky Mountain	119	116	106	121	114	121	95	111	106	104	91	90
California	1,160	1,386	1,476	1,438	1,426	1,303	1,176	1,135	1,124	1,163	1,200	1,351
Total United States	6,759	7,262	7,285	7,375	7,160	6,806	6,508	6,363	5,923	5,735	5,452	5,731
Total finished and unfinished gasoline stocks, United States:												
1938	85,873	92,280	92,320	90,059	88,147	80,531	76,732	70,962	69,086	69,277	69,535	71,680
1937	71,416	78,413	81,651	80,667	[1] 79,804	[1] 75,283	70,345	66,756	65,380	68,037	70,628	76,990

[1] Revised figures—stocks of finished gasoline, refinery, East Coast, May 31, revised to 5,625 and June 30 to 5,575; bulk terminal and pipe line, May 31, Appalachian revised to 1,493 and Indiana, Illinois, Kentucky, etc., to 3,347 (Minerals Yearbook, 1938, p. 874).

Days' supply of motor fuel on hand in the United States at end of month, 1936–38 [1]

Month	1936			1937			1938 [2]		
	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel	Finished gasoline	Natural gasoline	Total motor fuel
Jan	56.1	3.9	60.0	52.0	3.2	55.2	61.9	3.9	65.8
Feb	53.8	3.4	57.2	51.5	3.1	54.6	58.8	3.5	62.3
Mar	48.7	3.2	51.9	48.2	3.1	51.3	53.5	3.4	56.9
Apr	46.1	3.5	49.6	46.6	3.4	50.0	51.8	3.9	55.7
May	41.4	3.5	44.9	42.0	3.4	45.4	46.2	3.7	49.9
June	38.3	3.6	41.9	39.1	3.6	42.7	44.2	4.1	48.3
July	35.8	3.6	39.4	36.6	4.0	40.6	39.4	4.2	43.6
Aug	34.0	3.5	37.5	34.5	4.1	38.6	39.1	4.8	43.9
Sept	34.1	3.3	37.4	36.7	3.8	40.5	38.5	5.0	43.5
Oct	36.2	3.1	39.3	39.9	3.5	43.4	39.2	4.1	43.3
Nov	39.2	3.0	42.2	47.2	3.8	51.0	42.2	3.8	46.0
Dec	47.6	3.4	51.0	56.6	3.9	60.5	49.3	3.6	52.9

[1] Stocks divided by the daily average total demand (domestic demand plus exports) for succeeding month.
[2] Subject to revision.

Production by States.—Texas led in the production of gasoline, with the output of 182,427,000 barrels or 33 percent of the United States total, compared with only 30 percent in 1937. California, Pennsylvania, Indiana, and Oklahoma followed with 14, 8, 7, and 6 percent, respectively.

Consumption by States.—New York still leads in gasoline consumption in 1938, but it declined in relative importance in 1938. New York and California consumed about 8 percent each of the total, Pennsylvania 7 percent, and Illinois, Ohio, and Texas 6 percent each. (See fig. 10.)

Distribution.—The amount of motor fuel transported by pipe lines increased from 73,233,000 to 85,297,000 barrels (16 percent). Compared with the 2.5 percent increase in total motor-fuel demand, these statistics indicate that the tendency for the proportion of gasoline transported by pipe lines to increase is continuing.

Production and consumption of gasoline in the United States, 1936–38, by States

[Thousands of barrels]

State	1936		1937		1938	
	Production	Consumption [1]	Production	Consumption [1]	Production [2]	Consumption [1]
Alabama	(3)	4,872	(3)	5,378	(3)	5,483
Arizona		2,277		2,473		2,434
Arkansas	2,768	3,672	3,006	3,908	3,028	4,050
California	76,942	39,371	79,967	41,853	77,528	41,722
Colorado	729	4,875	752	5,263	1,170	5,404
Connecticut		7,129		7,784		7,606
Delaware		1,204		1,302		1,323
District of Columbia		3,029		3,262		3,316
Florida		7,452		7,831		8,062
Georgia	[4] 995	7,267	[5] 5,332	7,899	[5] 4,990	8,066
Idaho		2,092		2,253	(6)	2,255
Illinois	23,155	28,379	26,407	30,794	28,309	31,782
Indiana	40,227	13,780	42,940	15,091	40,737	15,046
Iowa		10,957		11,807		12,574
Kansas	[7] 30,710	10,722	[7] 32,481	11,195	[7] 31,231	11,167
Kentucky	[8] 4,053	5,436	[8] 4,287	5,996	[8] 4,729	6,109
Louisiana	[3] 25,724	5,152	[3 9] 26,405	5,679	[3] 24,791	5,899
Maine		3,203		3,463		3,449
Maryland	4,809	5,839	(5)	6,433	(5)	6,475
Massachusetts	[10] 4,863	15,661	[10] 5,586	16,583	[10] 4,625	16,432
Michigan	4,653	23,709	5,672	26,443	6,822	25,094
Minnesota		11,449		12,140		12,612

See footnotes at end of table.

Production and consumption of gasoline in the United States, 1936–38, by States—Continued

[Thousands of barrels]

State	1936		1937		1938	
	Production	Consumption	Production	Consumption	Production	Consumption
Mississippi		4,069		4,519		4,616
Missouri	(7)	13,514	(7)	14,060	(7)	14,373
Montana	1,678	2,655	2,317	2,760	2,562	2,824
Nebraska	(11)	5,485	(11)	5,455	(6)	5,489
Nevada		815		890		948
New Hampshire		1,926		2,031		2,028
New Jersey	26,388	17,750	30,302	19,538	26,214	19,748
New Mexico	[12] 2,632	1,806	[12] 3,148	2,111	[12] 3,100	2,145
New York	5,858	40,996	5,833	43,228	5,515	42,910
North Carolina		8,289		9,272		9,546
North Dakota		2,652		2,899		3,031
Ohio	19,520	28,642	22,323	31,161	21,517	30,448
Oklahoma	35,122	8,808	37,095	9,284	34,488	9,564
Oregon		5,138		5,401		5,469
Pennsylvania	43,031	30,554	46,164	33,749	43,353	33,419
Rhode Island	(10)	2,818	(10)	2,913	(10)	2,881
South Carolina	(4)	3,903	(5)	4,480	(5)	4,656
South Dakota	(11)	2,700	(11)	2,708	(6)	3,080
Tennessee	(8)	6,341	(8)	6,355	(8)	6,717
Texas	142,675	26,362	170,279	29,054	182,427	30,245
Utah	(12)	1,985	(12)	2,169	(12)	2,209
Vermont		1,429		1,567		1,531
Virginia		7,537		8,158		8,456
Washington		7,607		7,964		8,046
West Virginia	1,474	4,317	1,598	4,672	1,627	4,532
Wisconsin		12,012		12,883		12,916
Wyoming	[11] 6,805	1,397	[11] 7,247	1,524	[6] 7,087	1,478
Total United States	504,811	469,034	[9] 559,141	505,635	555,850	509,665

[1] American Petroleum Institute.
[2] Subject to revision.
[3] Alabama included with Louisiana.
[4] South Carolina included with Georgia.
[5] South Carolina and Maryland included with Georgia.
[6] Idaho, Nebraska, and South Dakota included with Wyoming.
[7] Missouri included with Kansas.
[8] Tennessee included with Kentucky.
[9] Revised figures.
[10] Rhode Island included with Massachusetts.
[11] Nebraska and South Dakota included with Wyoming.
[12] Utah included with New Mexico.

Shipments of motor fuel by pipe lines in the United States in 1938, by months

[Thousands of barrels]

	1938													1937 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Motor fuel turned into lines	6,192	5,391	6,318	6,473	7,233	7,382	7,518	8,335	7,965	7,789	7,604	7,392	85,592	74,147
Motor fuel delivered from lines	5,997	5,074	6,368	6,606	7,274	7,288	7,670	8,447	7,854	7,912	7,521	7,286	85,297	73,233
Shortage	20	2	23	34	31	20	34	48	30	34	34	20	330	260
Stocks in lines and working tanks, end of month	3,537	3,852	3,779	3,612	3,540	3,614	3,428	3,268	3,349	3,192	3,241	3,327	3,327	[1] 3,362

[1] Revised figures.

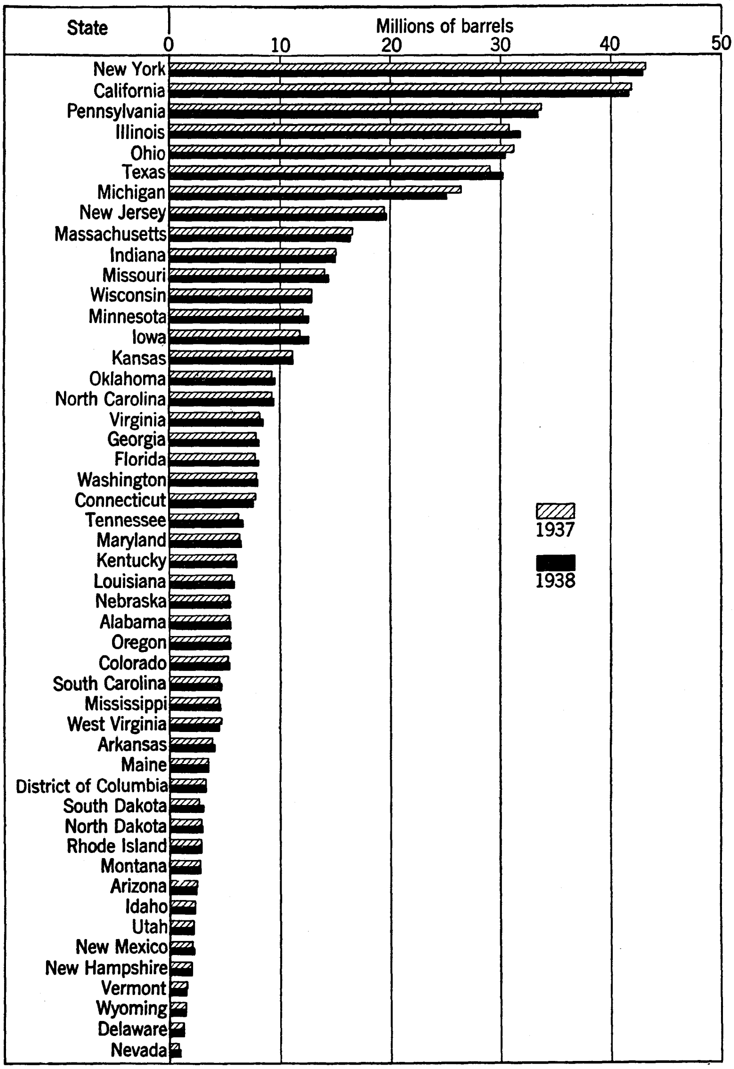

FIGURE 10.—Gasoline consumption, 1937–38, by States.

Boat shipments of gasoline from California to the East coast decreased from 4,144,000 barrels in 1937 to 2,965,000 in 1938, but the tanker movement from the Gulf coast to the East coast, which includes virtually all of the gasoline movement between these points, rose from 104,127,000 barrels in 1937 to 105,036,000 in 1938.

A comparison of prices at Gulf coast points and New York Harbor is interesting in connection with this movement. During 1937 the average price of gasoline in New York was 0.05 cent less per gallon than the average Gulf coast price plus the tanker rate to New York. In 1938, however, the average price of gasoline in New York was 0.66 cent more than the average Gulf coast price plus the tanker rate, and in December 1938 it was 0.71 cent more. The accompanying table shows these relationships in more detail.

KEROSENE AND RANGE OIL [2]

Kerosene statistics for 1938 show increased domestic demand and higher year-end stocks than in 1937, but production and exports in 1938 were below the 1937 totals. The production of kerosene dropped from 65,308,000 barrels in 1937 to 64,580,000 in 1938. This lower output of kerosene can be attributed to the running of slightly less crude oil to stills, as there was no change in the percentage of kerosene yield, which averaged 5.5 percent for both years. Domestic demand for kerosene increased from 54,972,000 barrels in 1937 to 56,351,000 in 1938, or by less than 3 percent, a gain somewhat below the average for recent years. A review of the kerosene domestic demand figures by quarterly totals reveals that a gain in the first quarter of 1938 over the same period of 1937 about equaled the net increase of 1,400,000 barrels for the entire year. Furthermore, demand in the second quarter of 1938 declined about 700,000 barrels in comparison with the same quarter of 1937, but this loss was made up by nominal gains realized in the closing quarters of the year.

Comparative analyses of statistics for kerosene in the United States, 1937–38, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
By months:								
January	5,923	5,638	6.3	5.8	[2] 5,286	5,360	5,622	6,523
February	4,866	5,167	5.7	5.9	[2] 4,225	5,017	5,443	5,986
March	5,187	5,798	5.5	6.0	[2] 4,820	5,150	5,396	6,093
April	4,907	5,445	5.2	5.7	4,465	4,333	5,047	6,394
May	5,343	5,649	5.3	5.7	[2] 4,149	3,637	5,576	7,627
June	5,087	5,235	5.1	5.6	3,259	3,257	6,781	9,202
July	5,482	4,889	5.2	4.9	3,594	3,752	7,553	10,112
August	5,726	4,933	5.4	4.9	3,667	4,292	8,637	10,149
September	5,371	5,348	5.2	5.5	4,397	4,187	8,839	10,497
October	5,731	5,320	5.5	5.3	4,985	5,185	8,877	9,949
November	5,876	5,419	5.9	5.6	5,705	5,368	8,357	9,676
December	5,809	5,739	5.9	5.9	6,420	6,813	7,083	7,799
Total United States	65,308	64,580	5.5	5.5	[2] 54,972	56,351	7,083	7,799
By districts:								
East Coast	11,024	9,208	5.6	5.1			1,512	1,356
Appalachian	3,220	2,769	8.0	7.1			132	184
Indiana, Illinois, Kentucky, etc.	6,238	7,096	3.8	4.3			558	702
Oklahoma, Kansas, and Missouri	7,396	6,960	6.1	6.3			620	743
Texas Inland	3,515	2,985	4.7	4.5	(3)	(3)	178	189
Texas Gulf Coast	20,351	22,357	7.2	7.3			2,095	2,722
Louisiana Gulf Coast	5,927	6,037	11.7	12.9			822	527
Arkansas and Louisiana Inland	1,787	2,139	7.2	8.9			173	192
Rocky Mountain	796	810	3.4	3.3			120	79
California	5,054	4,219	2.5	2.1			873	1,105
Total United States	65,308	64,580	5.5	5.5	[2] 54,972	56,351	7,083	7,799

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

Kerosene stocks increased from 7,083,000 barrels at the end of 1937 to 7,799,000 at the close of 1938. The 700,000 barrels of kerosene added to storage in 1938 is approximately half the stock increase in 1937. The smaller amount added to stocks in 1938 is directly connected with the lower production of kerosene for that year, as a gain of about 1,400,000 barrels in domestic demand was offset by a similar loss in exports.

Exports of kerosene dropped from 8,886,000 barrels in 1937 to 7,513,000 in 1938, the first decline in overseas trade since 1935. Many countries required less American kerosene in 1938 than in 1937; however, purchases by Denmark, Sweden, the United Kingdom, Canada, and the Philippines gained in 1938.

Annual surveys prior to 1937 covered only that portion of kerosene sold as range oil; however, petroleum refiners and jobbers were requested to report to the Bureau of Mines for 1937 all kerosene deliveries by States and principal uses. The 1937 returns show kerosene sales of 54,551,000 barrels, divided as follows: Sold as range oil, 30,099,000 barrels; tractor fuel, 4,251,000 barrels; and all other uses, 20,201,000 barrels.

Sales of range oil in the United States, 1935–37, by States [1]

[Thousands of barrels]

State	1935	1936	1937	
			Total	Percent of total
Massachusetts	7,203	8,219	9,645	29.6
New York	3,222	4,811	5,817	17.8
Connecticut	2,223	2,511	2,972	9.1
New Jersey	1,200	2,210	2,722	8.4
Rhode Island	1,354	1,744	2,079	6.4
Maine	800	981	1,108	3.4
Illinois	305	595	762	2.3
New Hampshire	561	639	708	2.2
Pennsylvania	299	538	639	2.0
Vermont	389	411	480	1.5
California	426	427	470	1.4
Maryland	394	357	443	1.4
North Carolina	238	268	312	1.0
Minnesota	209	221	302	.9
Other States	2,703	3,360	4,121	12.6
Total United States	21,526	27,292	32,580	100.0

[1] Figures for 1938 by States not yet available.

In recent years, as the demand for range oil has expanded rapidly, some No. 1 fuel oil has been sold for range fuel, replacing kerosene. In 1937, the fuel oil delivered for range fuel was reported as a separate item for the first time, and final figures show range-oil sales of 32,580,000 barrels, comprising 30,099,000 barrels of kerosene and 2,481,000 barrels of No. 1 fuel oil. Range-oil sales were 27,292,000 barrels in 1936, and it is estimated that about 2,000,000 barrels of the total was No. 1 fuel oil and the balance kerosene.

Sales of kerosene in the United States in 1937, by regions, States, and uses

[Thousands of barrels]

Region and State	Sold as range oil	Tractor fuel	All other uses	Total
Pacific Coast: [1]				
Washington	75		15	90
Oregon	58		6	64
California	470		900	1,370
Arizona	37		38	75
Nevada	15			15
Rocky Mountain:				
Idaho	4	14	8	26
Montana	4	57	45	106
Wyoming	2	17	17	36
Utah	21	8	10	39
Colorado	17	73	47	137
New Mexico	17	25	44	86
North Central:				
North Dakota	28	164	33	225
South Dakota	61	147	77	285
Minnesota	111	264	478	853
Nebraska	93	252	114	459
Iowa	101	285	686	1,072
Wisconsin	124	207	534	865
Illinois	465	347	1,553	2,365
Indiana	75	136	1,054	1,265
Michigan	141	129	692	962
Ohio	224	169	753	1,146
Kentucky	19	28	441	488
Tennessee	106	96	461	663
South Central:				
Missouri	232	154	705	1,091
Kansas	181	280	235	696
Texas	206	378	1,265	1,849
Oklahoma	104	154	531	789
Arkansas	183	69	455	707
Louisiana	203	46	629	878
Mississippi	80	92	312	484
Alabama	67	37	456	560
New England:				
Maine	1,014	5	68	1,087
New Hampshire	703		54	757
Vermont	474	1	41	516
Massachusetts	9,369	14	319	9,702
Rhode Island	2,036		100	2,136
Connecticut	2,858	5	210	3.073
Middle Atlantic:				
New York	5.417	125	1,117	6.659
New Jersey	2,526	35	1,261	3,822
Pennsylvania	562	127	1,294	1,983
Delaware	76	4	22	102
Maryland	439	27	488	954
District of Columbia	49	3	84	136
South Atlantic:				
Virginia	212	15	532	759
West Virginia	41	8	149	198
North Carolina	308	75	634	1,017
South Carolina	65	32	426	523
Georgia	191	52	390	633
Florida	235	95	418	748
Total United States	30,099	4,251	20,201	54,551

[1] Estimated.

An upward trend in representative kerosene prices evidenced in recent years continued into 1938. There was, however, only a moderate advance in the Oklahoma refinery price, which averaged 4.19 cents per gallon in 1938 compared with 4.17 cents per gallon in 1937 and 3.69 cents per gallon in 1936. The average monthly quotations show high levels of 4.31 cents per gallon for both January and July and a low price of 4.04 cents per gallon in October, followed by an advance to an average of 4.09 cents per gallon for December.

The increase in the tank-wagon price, represented by quotations at Chicago, was more pronounced, as the average advanced from

10.04 cents per gallon in 1937 to 10.31 cents per gallon in 1938. A tank-wagon price of 10.2 cents per gallon ruled until late in March of 1938, when the quotation was raised to 10.5 cents per gallon to cover a 10-percent freight-rate increase in that marketing area. This higher price held until October, when the quotation dropped to 10 cents per gallon, where it remained until the end of the year.

FUEL OILS[3]

The domestic demand for light or distillate fuel oils used principally for heating purposes remained at the same level in 1938 as in 1937; due largely to the decline in industrial consumption, however, the requirements for residual fuel oils fell sharply in 1938 compared with the record deliveries in 1937. Exports of fuel oils continued to expand in 1938 and established a new all-time record. The production of distillate fuel oils increased in 1938 over 1937; but the new supply of residual fuel oils, as measured by production, crude oil transferred to the fuel-oil account, and imports, reflecting the contracted demand for industrial fuel in 1938, declined sharply. The increase in fuel-oil stocks in 1938 was double the quantity added in 1937.

Domestic deliveries of fuel oils dropped from a record of 442,355,000 barrels in 1937 to 409,214,000 in 1938. The domestic demand for distillate fuel oils held in 1938, notwithstanding unfavorable economic conditions, because of heating-oil requirements and deliveries totaled 116,564,000 barrels or about the same quantity as in 1937. The inactive demand for industrial fuel caused the market for residual fuel oils to slump sharply in 1938; consequently, domestic requirements of 292,650,000 barrels were lower by 10 percent than the 1937 total of 325,514,000 barrels.

Salient statistics of fuel oils in the United States, 1937–38

[Thousands of barrels]

	1937			1938[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	22,813	84,236	107,049	22,566	[2] 81,507	104,073
Production	146,706	312,064	[3] 458,770	151,774	294,972	[3] 446,746
Transfers in California from crude oil to residual fuel oil		17,423	17,423		10,660	10,660
Imports:						
Bonded	1	19,613	19,614		18,081	18,081
Duty paid	16	2,501	2,517		2,904	2,904
Exports	30,129	15,304	45,433	29,903	17,728	47,631
Stocks at end of year	22,566	95,019	117,585	27,873	97,746	125,619
Indicated domestic demand:						
Class I railroads, purchases[4]	(5)	(5)	69,292	(5)	(5)	57,955
Public-utility power plants[6]	(5)	(5)	14,143	(5)	(5)	13,039
Bunker oil, foreign trade	(5)	(5)	36,129	(5)	(5)	33,983
All other demands	(5)	(5)	322,791	(5)	(5)	304,237
	116,841	325,514	442,355	116,564	292,650	409,214

[1] Subject to revision.
[2] New basis.
[3] Includes production by cracking: 1937, 235,739; 1938, 252,245.
[4] Interstate Commerce Commission; total includes Diesel fuel.
[5] Figures not available.
[6] Federal Power Commission.

[3] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

An examination of fuel-oil deliveries in 1938 by quarters compared with 1937 reveals that the demand for distillate fuel oils declined by 3 percent in each of the first two quarters of 1938 but that in the third quarter there was a gain of 8 percent over the corresponding 1937 period. This improved market did not hold, however, and the deliveries in the closing 3 months of 1938 were slightly below the requirements in the same quarter of 1937. Deliveries of residual fuel oils show serious losses for most of 1938 compared with 1937. This decline dipped to 17 percent in the second quarter of 1938 but was less marked thereafter, and the year closed with a 3-percent gain in the fourth quarter of 1938 compared with the final quarter of 1937.

The sharp decline in the demand for residual fuel oils in 1938 may be ascribed partly to the smaller purchases by Class I railroads reported by the Interstate Commerce Commission. The railroads, important users of heavy fuel oils, bought 57,955,000 barrels of fuel oils (including Diesel fuel) in 1938, or 16 percent less than the 69,292,000 barrels required in 1937. The Bureau of Foreign and Domestic Commerce, United States Department of Commerce, reports that vessels engaged in foreign trade loaded 33,983,000 barrels of bunker oil in 1938, 6 percent less than the 36,129,000 barrels loaded in 1937. Fuel-oil purchases by public-utility power plants compiled by the Federal Power Commission were 13,039,000 barrels in 1938—8 percent below the 1937 total of 14,143,000 barrels. If the present known items covering railroad, foreign bunker, and public-utility power-plant purchases of fuel oils in 1938 are subtracted from the indicated domestic demand for fuel oils in 1938, it is found that the remaining quantity available for all other uses, such as coastwise bunkers, industrial fuel, heating of buildings, Government requirements, and oil-company consumption in connection with petroleum production and refining, is 304,237,000 barrels for 1938 compared with 322,791,000 barrels for 1937. It is believed that the Bureau's annual fuel-oil survey for 1938 when completed will reveal that the larger portion of this loss is confined to the quantity used by smelters, mines, and manufacturing plants, due to their retarded operations in that year.

Figure 11 illustrates the trend in fuel-oil sales by principal uses, 1926–37. The sales include all grades of light and heavy fuel oils, as well as kerosene sold as range oil.

Sales of gas oil, fuel oil,[1] and range oil, 1933–37, by uses [2]

[Thousands of barrels]

Use	1933 [3]	1934	1935	1936	1937
Gas oil and fuel oil:					
Railroads	48,305	52,581	55,651	61,727	69,458
Ships' bunkers (including tankers)	70,445	69,262	74,581	80,324	84,990
Gas and electric power plants	22,507	23,143	23,647	26,799	26,510
Smelters and mines	2,538	2,682	2,448	3,768	75,298
Manufacturing industries	48,962	54,260	61,128	67,558	
Heating oils	50,140	60,822	76,853	99,257	116,583
U. S. Navy, Army transports, etc	8,000	7,914	10,428	9,241	9,135
Oil-company fuel	46,200	47,404	48,116	46,021	42,924
Miscellaneous uses	11,250	12,253	13,133	13,714	14,424
Total United States	308,347	330,321	365,985	408,409	439,322
Exports and shipments to noncontiguous Territories	20,563	28,605	28,948	34,883	45,433
	328,910	358,926	394,933	443,292	484,755
Range oil	10,269	15,756	21,526	27,292	32,580

[1] Includes some crude oil burned as fuel.
[2] Figures for 1938 not yet available.
[3] Partly estimated.

Exports of fuel oils, including shipments to noncontiguous Territories of the United States, increased from 45,433,000 barrels in 1937 to 47,631,000 in 1938. The upward trend in fuel-oil overseas trade, which began in 1933, continued into 1938, when the domestic demand declined; in fact, the 1938 export total of 47,631,000 barrels is an all-time record, surpassing the former record attained in 1927 by a quarter of million barrels. The gain in exports in 1938 was limited to the heavy or residual grades, which increased from 15,304,000 barrels in 1937 to 17,728,000 in 1938. Exports of distillate fuel oils

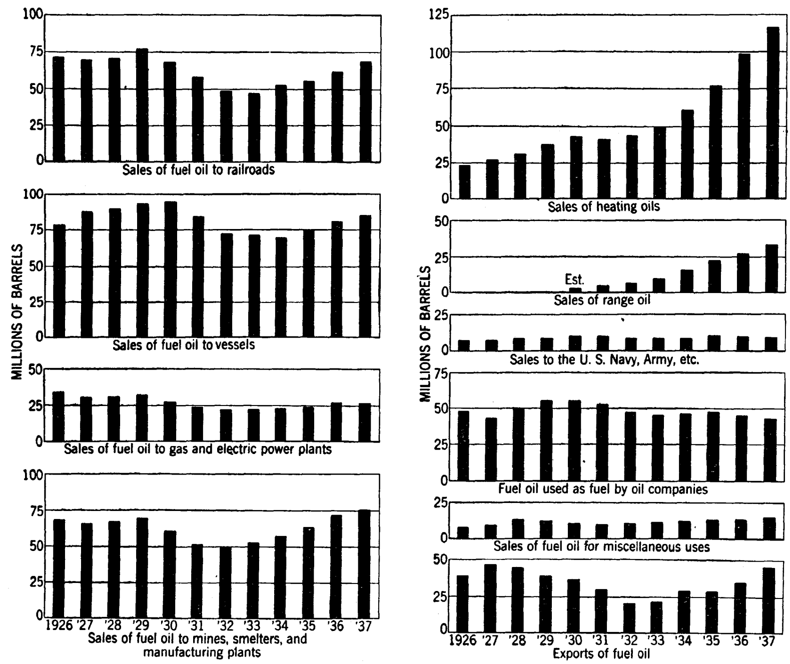

FIGURE 11.—Sales of fuel oils and range oil, 1926-37, by uses.

totaling 29,903,000 barrels in 1938 are approximately 1 percent under the 1937 quantity (30,129,000 barrels).

Germany and the United Kingdom increased their purchases of American distillate fuel oils in 1938 over 1937, while other important buyers, such as Japan, Netherland West Indies, Belgium, and Sweden, required less in 1938 than in 1937. The light fuel-oil trade with Japan totaled 5,297,000 barrels in 1938, a quantity about a million barrels below 1937 requirements.

Smaller exports of residual fuel oils to Japan, Chile, and Mexico in 1938 compared with 1937 were more than offset by increased shipments in 1938 to a number of countries, including Netherlands, United Kingdom, Italy, Spain, Canada, Cuba, Panama, and the Philippines. Residual fuel-oil exports to Japan decreased from 4,045,000 barrels in 1937 to 3,030,000 in 1938; however, this loss was more than counterbalanced by a gain in heavy fuel-oil shipments to Cuba, which increased from 247,000 barrels in 1937 to 1,356,000 in 1938. Further information on exports is given in the section entitled "United States Trade."

Sales of gas oil and fuel oils[1] *in the United States, 1933–37, by regions and States*[2]

[Thousands of barrels]

Region and State	1933	1934	1935	1936	1937
Pacific Coast:					
Washington	8,312	8,485	8,976	9,331	11,352
Oregon	5,430	6,079	7,773	9,918	10,879
California	59,893	63,801	66,627	65,895	70,952
Arizona	448	729	2,545	2,585	3,994
Nevada	522	664	2,182	2,791	3,790
Rocky Mountain:					
Idaho	67	82	140	223	516
Montana	1,098	1,221	1,676	1,652	1,797
Wyoming	1,234	1,264	1,418	1,549	1,794
Utah	203	254	260	404	501
Colorado	371	400	464	581	623
New Mexico	468	753	835	715	558
North Central:					
North Dakota	183	199	269	294	375
South Dakota	294	353	474	536	599
Minnesota	2,697	2,796	2,986	4,093	4,993
Nebraska	1,125	1,152	1,315	1,743	1,935
Iowa	1,073	1,032	1,378	1,873	2,171
Wisconsin	2,017	2,415	2,992	4,022	4,690
Illinois	11,861	13,206	15,037	18,351	20,667
Indiana	6,264	6,199	6,935	7,450	7,876
Michigan	5,723	7,631	8,634	9,000	9,727
Ohio	5,381	5,393	5,826	7,173	8,024
Kentucky	640	749	815	799	972
Tennessee	390	500	328	387	579
South Central:					
Missouri	5,098	5,456	6,583	7,605	8,918
Kansas	5,924	6,693	7,394	7,764	7,331
Texas	38,696	38,368	39,382	41,841	43,195
Oklahoma	9,698	9,836	9,581	9,461	9,075
Arkansas	2,276	2,345	2,544	2,876	2,655
Louisiana	8,663	8,585	10,481	11,614	12,345
Mississippi	231	265	476	593	794
Alabama	1,127	1,174	1,294	1,545	1,877
New England:					
Maine	1,829	1,487	1,756	2,328	2,396
New Hampshire	734	885	1,176	1,363	1,508
Vermont	296	353	393	458	560
Massachusetts	12,786	14,394	17,187	18,829	21,522
Rhode Island	5,591	6,412	6,591	6,894	7,240
Connecticut	3,692	4,862	5,742	7,047	7,708
Middle Atlantic:					
New York	28,097	30,367	36,087	42,215	43,028
New Jersey	30,193	30,646	32,554	41,458	44,036
Pennsylvania	19,751	21,871	23,452	26,098	26,243
Delaware	765	865	914	1,335	1,659
Maryland	6,217	7,053	7,715	8,423	9,545
District of Columbia	1,141	1,190	1,509	1,911	2,105
South Atlantic:					
Virginia	1,369	1,808	2,575	3,420	3,634
West Virginia	613	576	919	840	807
North Carolina	253	334	402	504	587
South Carolina	367	549	509	591	640
Georgia	1,211	1,280	1,497	1,744	1,776
Florida	6,035	7,310	7,387	8,287	8,774
Total United States	308,347	330,321	365,985	408,409	439,322

[1] Includes some crude oil burned as fuel.
[2] Figures for 1938 not yet available.

Crude oil runs to stills in 1938 totaling 1,165,015,000 barrels represents a decline of less than 2 percent compared with the 1937 throughput of 1,183,440,000 barrels; however, the production of fuel oils changed by nearly 3 percent, decreasing from 458,770,000 barrels in 1937 to 446,746,000 in 1938. The lower yield of fuel oils in 1938 represents a net loss, as the distillate fuel-oil output increased—probably in anticipation of an expanding demand for heating oils—by nearly 4 percent, or from 146,706,000 barrels in 1937 to 151,774,000 in 1938, while the production of residual fuel oils was reduced, because of slackened market demand, by over 5 percent, totaling 294,972,000 barrels in 1938 compared with 312,064,000 in 1937. The increased production of light fuel oils and the cut in the heavy fuel-oil output in 1938 were brought about largely by varying the average yield factors, which for the distillate grades increased from 12.4 percent in 1937 to 13.0 in 1938, whereas the average yield for residual fuel oils was reduced from 26.4 percent in 1937 to 25.3 in 1938.

Comparative analyses of statistics for gas oil and distillate fuel oils in the United States, 1937–38, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
By months:								
January	13,319	13,876	14.1	14.2	[2] 14,847	12,642	19,088	21,543
February	11,206	12,144	13.2	13.8	[2] 10,550	11,651	18,211	19,885
March	11,005	12,294	11.7	12.8	[2] 10,532	10,487	16,724	18,882
April	10,674	11,577	11.4	12.1	[2] 7,999	7,800	16,889	19,972
May	11,158	12,160	11.1	12.2	[2] 6,805	7,050	18,451	22,385
June	11,088	10,784	11.2	11.5	[2] 6,249	5,490	20,657	24,699
July	12,654	12,688	12.1	12.7	6,584	7,863	23,637	26,620
August	12,558	12,691	11.9	12.5	7,197	7,737	25,952	28,841
September	12,681	13,074	12.3	13.5	8,672	8,627	27,020	30,860
October	13,585	13,820	12.9	13.7	[2] 9,939	10,089	28,101	33,017
November	13,215	12,793	13.3	13.1	11,639	11,472	26,852	32,069
December	13,563	13,873	13.8	14.2	15,828	15,656	22,566	27,873
Total United States	146,706	151,774	12.4	13.0	[2] 116,841	116,564	22,566	27,873
By districts:								
East Coast	30,020	28,559	15.2	15.8	(3)	(3)	5,090	5,821
Appalachian	2,756	2,446	6.8	6.2			256	270
Indiana, Illinois, Kentucky, etc.	17,033	17,397	10.4	10.7			2,538	3,427
Oklahoma, Kansas, and Missouri	11,434	11,163	9.4	10.0			1,344	1,443
Texas Inland	5,423	4,217	7.2	6.3			285	395
Texas Gulf Coast	39,385	47,529	14.0	15.4			5,048	5,462
Louisiana Gulf Coast	7,800	7,450	15.4	15.9			910	1,043
Arkansas and Louisiana Inland	2,428	2,341	9.7	9.7			111	268
Rocky Mountain	1,462	1,689	6.3	6.8			204	271
California	28,965	28,983	14.3	14.5			6,780	9,473
Total United States	146,706	151,774	12.4	13.0	[2] 116,841	116,564	22,566	27,873

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

The Texas Gulf Coast was the only important refining area to show a gain in the production of fuel oils in 1938, the output increasing from 112,608,000 barrels in 1937 to 121,303,000 in 1938. There was, however, little change in that area in the yield of residual fuel oils, which amounted to about 73,000,000 barrels for both 1937 and 1938, while the distillate grades increased from 39,385,000 barrels in 1937 to 47,529,000 in 1938. California refineries, the chief source of residual fuel oils, are credited with a fuel-oil production of 115,024,000 barrels in 1938 compared with 116,665,000 barrels in 1937. Both light and heavy fuel oils were produced in reduced quantities in the East Coast region in 1938, the total yield declining from 85,294,000 barrels in 1937 to 79,281,000 in 1938. The Indiana-Illinois area produced 40,716,000 barrels of fuel oils in 1938, 1,300,000 barrels less than the 1937 output. In that territory a small gain in the production of distillate fuel oils was offset by a decline in the yield of residual fuel oils from 24,953,000 barrels in 1937 to 23,319,000 in 1938.

In the California area some crude oil, below standard for refining purposes, is transferred each year to the fuel-oil account. These transfers increased steadily as the demand for fuel oils developed, reaching a peak of 17,423,000 barrels in 1937 but dropping to 10,660,000 barrels in 1938. This decrease in the transfer of crude oil to the fuel-oil supply in 1938 apparently is associated with the lower demand for heavy fuel oils, as the non-gasoline-bearing crude available for fuel oil use was several times the quantity actually shifted to the fuel-oil inventory. Furthermore, the price of crude oil in California remained virtually unchanged during 1938 compared with a drop from $1.00 to $0.80 per barrel for heavy fuel oil, so that there was less incentive to make transfers from crude to the fuel-oil account.

The supply of fuel oils was augmented by imports in 1938 of 20,985,000 barrels compared with 22,131,000 barrels in 1937. Nearly all this fuel oil originated in the Netherland West Indies, and the larger share was entered at the Port of New York. Most of the fuel oil imported is received in bond and is released later for the bunkering of vessels, without payment of import duty. There were no imports of distillate fuel oils in 1938. Imports of residual fuel oils in 1937 and 1938 were classified as follows—18,081,000 barrels received in bond in 1938 compared with 19,613,000 in 1937, and duty paid for domestic use on 2,904,000 barrels in 1938 and 2,501,000 in 1937.

Curtailed domestic demand caused fuel-oil stocks to increase heavily in 1938, when over 21,500,000 barrels were added to storage compared with a gain in stocks of 10,500,000 barrels in 1937. As of January 1, 1938, stocks of unmixed heavy crude in California were separated from other fuel-oil stocks. On the new basis, the gain in residual fuel-oil stocks for the United States as a whole in 1938 was 16,239,000 barrels compared with a gain of 10,783,000 barrels in 1937. Stocks of distillate fuel oils increased by 5,307,000 barrels in 1938 in contrast to a decline of 247,000 barrels in 1937.

The gain in 1938 of 5,300,000 barrels in distillate fuel-oil stocks was divided about equally between the California area, with an increase of 2,700,000 barrels, and the rest of the country, where 2,600,000 barrels were added to storage. The more important changes in light fuel-oil stocks in 1938, outside of California, occurred in the Indiana-Illinois refining area, where approximately 900,000 barrels were added; the East Coast district, with a gain of about 700,000 barrels; and the Texas Gulf Coast district, with an increase of 400,000 barrels.

The major stock increase for 1938 is for the California area, where approximately 16,600,000 barrels of residual fuel oils were added to storage during the year, largely as a result of lower domestic and export demand. Heavy fuel-oil inventories in refining areas other than California made a net decline of about 400,000 barrels in 1938. There was a shrinkage of 1,400,000 barrels in the volume of residual fuel oils held in the Louisiana Gulf Coast district and smaller stock losses for the Appalachian and Indiana-Illinois areas. All other districts east of California showed gains in heavy fuel-oil stocks for 1938; the larger increase was in the Oklahoma-Kansas-Missouri group of States, where over 600,000 barrels of residual fuel oils were added to storage.

Comparative analyses of statistics for residual fuel oils in the United States, 1937–38, by months and districts

	Production (thousands of barrels)		Yield (percent)		Transfers (thousands of barrels)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1937 [1]	1938 [2]	1937	1938 [2]	1937	1938 [2]	1937 [1]	1938 [2]	1937	1938 [2]
By months:										
January	25,623	26,204	[1] 27.2	26.8	1,671	1,230	28,116	25,844	[1] 83,406	[3] 83,902
February	22,302	23,866	26.2	27.1	1,222	1,285	27,511	23,627	80,571	85,753
March	25,191	25,328	[1] 26.7	26.4	1,369	1,047	29,789	25,696	78,435	86,920
April	24,100	24,833	[1] 25.8	26.0	1,699	843	27,874	22,279	77,318	90,893
May	26,587	24,392	[1] 26.5	24.6	1,503	846	26,530	22,447	79,158	93,753
June	26,033	22,761	[1] 26.2	24.2	1,459	815	26,250	22,278	81,224	95,690
July	26,958	23,547	25.7	23.6	1,191	830	25,890	20,548	84,154	99,363
August	26,026	24,232	[1] 24.7	23.9	1,762	662	26,391	23,775	86,420	100,431
September	27,094	24,552	[1] 26.2	25.3	845	666	26,408	23,082	89,007	102,831
October	28,425	25,487	[1] 27.1	25.3	1,468	882	26,913	25,666	92,182	103,423
November	26,687	24,573	[1] 26.8	25.1	1,392	894	26,180	27,621	93,225	101,569
December	27,038	25,197	[1] 27.5	25.7	1,842	660	27,662	29,787	95,019	97,746
Total United States	312,064	294,972	[1] 26.4	25.3	17,423	10,660	325,514	292,650	95,019	97,746
By districts:										
East Coast	55,274	50,722	[1] 27.9	28.1					7,421	7,413
Appalachian	4,315	4,725	[1] 10.7	12.1					860	568
Indiana, Illinois, Kentucky, etc.	24,953	23,319	[1] 15.2	14.3					4,309	4,025
Oklahoma, Kansas, and Missouri	21,819	19,101	[1] 18.0	17.2					2,871	3,527
Texas Inland	20,914	15,871	[1] 27.7	23.7			(4)	(4)	1,681	2,113
Texas Gulf Coast	73,223	73,774	26.0	24.0					6,775	6,978
Louisiana Gulf Coast	13,212	10,806	[1] 26.0	23.0					2,581	1,162
Arkansas and Louisiana Inland	6,215	5,697	[1] 24.9	23.6					324	586
Rocky Mountain	4,439	4,916	[1] 19.0	19.8					541	619
California	87,700	86,041	[1] 43.2	42.9	17,423	10,660			67,656	70,755
Total United States	312,064	294,972	[1] 26.4	25.3	17,423	10,660	325,514	292,650	95,019	97,746

[1] Revised figures.
[2] Subject to revision.
[3] Stocks on new basis; corresponding United States total for January 1, 1938, 81,507, and for California, 54,144.
[4] Figures not available.

Monthly refinery reports reveal a shipment of 59,000 barrels of residual fuel oil from California to the East coast in October, 1938, which may be significant, as it is the first heavy fuel-oil movement in that direction since November 1934. Similar shipments appear for November and December 1938, making a total of 338,000 barrels for the year. The market price of heavy fuel oil on the Pacific coast plus tanker rates do not apparently justify such movement at this time; however, the need for additional outlets for California heavy fuel oil and possible anticipation of a rising demand for industrial fuel oils in the eastern area, where excessive stocks are not a factor, may all be underlying reasons for revival of this trade. The shipment of distillate fuel oils from California to the East dropped from 726,000 barrels in 1937 to 321,000 in 1938.

The movement of distillate fuel oils from the Gulf coast to eastern ports increased from 27,452,000 barrels in 1937 to 29,187,000 in 1938, while the transfer of residual oils changed but slightly, totaling 56,987,000 barrels in 1938 and 56,891,000 in 1937.

The price of fuel oils showed a marked downward trend in 1938 due more to an inactive market demand than to the influence of changing crude-oil prices, which were fairly well maintained at an average of $1.15 per barrel in 1938 compared with $1.18 per barrel in 1937. A review of refinery and market prices in all sections of the country discloses, with few exceptions, lower quotations for fuel oils at the end of 1938 than at the close of 1937.

Lower tanker rates forced a reduction in the New York price of Bunker C fuel oil on March 11, 1938, from $1.25 to $1.15 per barrel and a relative decline in the quotation at Gulf coast points to $0.85 per barrel. Bunker C fuel oil in the Pacific market dropped from a February average of $0.99 per barrel to a March average of $0.96 per barrel. A further decline of 10 cents per barrel in the price of Bunker C at Atlantic coast points became effective April 5, 1938, making the New York quotation $1.05 per barrel. Still lower tanker rates and a competitive market due to reduced industrial demand were given as the reasons for the price cut. At this time Bunker C was reduced by only 5 cents per barrel to $0.80 on the Gulf coast, while Pacific coast prices showed no reaction until early May, when the average quotation declined from $0.95 to $.89 per barrel. There was a general reduction in the price of light and heavy fuel oils along the Atlantic seaboard during the week ending June 25, 1938, due to a slackened demand and mounting stocks. Bunker C fuel oil at New York was dropped from $1.05 to $0.95 per barrel, and this price held until the end of the year. The Gulf coast quotation, reflecting this general reduction, declined by 5 cents to $0.75 per barrel; however, there was no general change in the Bunker C price in the California marketing area until early August, when the price dropped to $0.80 per barrel for the balance of 1938.

Monthly average prices of kerosene and fuel oil in the United States, 1937–38 [1]

	January	February	March	April	May	June	July	August	September	October	November	December	Average for year
1937													
41°–43° gravity w. w. kerosene at refineries, Oklahoma cents per gallon	3.89	4.22	4.25	4.27	4.30	4.26	4.16	4.13	4.13	4.13	4.13	4.16	4.17
Kerosene, tank-wagon at Chicago cents per gallon	9.57	9.80	10.10	10.10	10.10	10.10	10.10	10.10	10.10	10.10	10.15	10.20	10.04
No. 1 straw distillate at refineries, Oklahoma cents per gallon	3.66	3.97	3.93	3.81	3.80	3.75	3.75	3.76	3.81	3.88	3.89	4.00	3.83
28°–30° gravity zero distillate at refineries, Oklahoma cents per gallon	3.47	3.56	3.50	3.44	3.44	3.40	3.25	3.26	3.34	3.56	3.58	3.63	3.45
Bunker C for ships:													
New York dollars per barrel	1.15	1.20	1.20	1.20	1.28	1.35	1.35	1.35	1.35	1.35	1.27	1.25	1.27
Gulf coast do	.95	1.00	1.00	1.00	1.03	1.05	1.05	1.05	1.05	1.05	.97	.95	1.01
California do	.93	.94	.93	.93	.95	1.09	1.09	1.09	1.09	1.09	1.09	1.06	1.02
Diesel oil for ships:													
New York dollars per barrel	1.80	1.85	1.85	1.85	2.10	2.18	2.20	2.20	2.20	2.20	2.20	2.20	2.07
Gulf coast do	1.58	1.65	1.65	1.65	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.81
California do	1.09	1.26	1.30	1.30	1.33	1.55	1.64	1.64	1.64	1.64	1.64	1.64	1.47
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

[1] National Petroleum News.

[2] Figures not quoted.

Retail price quotations for heating oils, as compiled by the Bureau of Labor Statistics, United States Department of Labor, exhibit the general downward trend of fuel-oil prices in 1938. The Chicago retail price for No. 2 heating oil was quoted at an average of 7.21 cents per gallon during the first half of 1938; however, by the opening of the heating season in September it had fallen to 7.08 cents per gallon. December average prices show a slight upturn to 7.15 cents per gallon for the Chicago market. The New York retail price for No. 2 heating oil dropped steadily during the year, from 7.65 cents per gallon in December 1937 to 6.60 cents per gallon in December 1938.

LUBRICANTS

The domestic demand for lubricants declined 9 percent, from 23,323,000 barrels in 1937 to 21,248,000 in 1938. Most of the decline was in that used for industrial purposes, which dropped from 10,483,000 to 8,700,000 barrels (17 percent). The accompanying table shows estimates of the proportions of lubricating oil used for automotive and industrial purposes.

Exports of lubricants declined 14 percent, or from 10,975,000 barrels in 1937 to 9,402,000 in 1938, making a decrease of approximately 11 percent in total demand.

Production of lubricants declined from 35,321,000 to 30,826,000 barrels. The East Coast and the Texas Gulf Coast districts each produced 24.7 percent of this total. This is the largest proportion that the Texas Gulf Coast district has supplied during the past 10 years, while the figure for the East Coast district is the lowest of a 10-year downward trend. Aside from these developments, production statistics by districts show no significant changes.

Domestic demand for lubricating oils, 1929–38

[Thousands of barrels]

Year	Automotive				Industrial	Total demand
	Passenger cars	Trucks	Busses	Total		
1929	9,754	2,010	188	11,952	11,657	23,609
1930	9,899	2,004	213	12,116	9,473	21,589
1931	9,782	1,965	221	11,968	8,100	20,068
1932	8,780	1,739	216	10,735	5,879	16,614
1933	8,516	1,757	212	10,485	6,667	17,152
1934	8,920	1,920	227	11,067	7,417	18,484
1935	9,098	2,043	241	11,382	8,279	19,661
1936	9,721	2,270	255	12,246	10,077	22,323
1937 [1]	10,115	2,455	270	12,840	10,483	23,323
1938 [2]	9,924	2,365	259	12,548	8,700	21,248

[1] Revised figures.
[2] Subject to revision

Comparative analyses of statistics for lubricants in the United States, 1937–38, by months and districts

	Production (thousands of barrels)		Yield (percent)		Domestic demand (thousands of barrels)		Stocks (thousands of barrels)	
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
By months:								
January	2,649	2,785	2.8	2.8	[2] 1,625	1,471	6,788	8,006
February	2,728	2,468	3.2	2.8	[2] 1,429	1,311	7,115	8,363
March	[2] 2,873	2,697	3.0	2.8	[2] 2,500	2,195	6,771	8,210
April	3,048	2,530	3.3	2.6	2,224	1,591	6,556	8,290
May	3,141	2,595	3.1	2.6	[2] 2,079	1,730	6,478	8,255
June	[2] 2,978	2,378	3.0	2.5	[2] 2,028	1,606	6,447	8,114
July	2,980	2,631	2.8	2.6	[2] 1,985	1,844	6,566	8,194
August	2,900	2,576	2.8	2.5	[2] 1,925	2,002	6,426	7,969
September	2,920	2,615	2.8	2.7	1,968	2,127	6,542	7,605
October	3,215	2,632	3.1	2.6	[2] 2,028	1,805	6,789	7,718
November	2,953	2,535	3.0	2.6	2,037	1,735	6,907	7,817
December	2,936	2,384	3.0	2.4	[2] 1,495	1,831	7,512	7,695
Total United States	35,321	30,826	3.0	2.6	[2] 23,323	21,248	7,512	7,695
By districts:								
East Coast	9,360	7,613	4.7	4.2	(3)	(3)	2,355	2,230
Appalachian	6,083	5,763	15.1	14.7			807	910
Indiana, Illinois, Kentucky, etc	3,457	2,609	2.1	1.6			667	577
Oklahoma, Kansas, and Missouri	3,659	2,962	3.0	2.7			710	565
Texas Inland	229	213	.3	.3			85	64
Texas Gulf Coast	7,929	7,628	2.8	2.5			1,406	1,810
Louisiana Gulf Coast	1,246	1,097	2.5	2.3			150	192
Arkansas and Louisiana Inland	467	452	1.9	1.9			69	44
Rocky Mountain	305	205	1.3	.8			108	101
California	2,586	2,284	1.3	1.1			1,155	1,202
Total United States	35,321	30,826	3.0	2.6	[2] 23,323	21,248	7,512	7,695

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

Stocks of lubricants—7,695,000 barrels on December 31, 1938—were 183,000 barrels higher than on December 31, 1937. The largest gain was in the Texas Gulf Coast area, where they increased 404,000 barrels to total 1,810,000 barrels. Stocks also increased in the California, Appalachian, and Louisiana Gulf Coast areas but declined in the other districts.

Lubricating-oil prices in general did not change greatly in 1938 after their precipitous drop in 1937. A Pennsylvania neutral selling for 18.75 cents in early January slumped to 13.00 cents in June but subsequently recovered to 15.5 cents in December. Pennsylvania steam-refined cylinder stocks that sold for 7.75 cents in early January rose to 9.00 cents in the late spring and were selling at 8.00 cents at the close of the year. The price of Gulf Coast neutral oil that sold for 8.50 cents in January encountered a persistent downward trend and had drifted to 7.63 cents in December.

There is a pronounced difference in the long-term trends in the prices of lubricating oils. The average prices in 1938 of the Oklahoma, Pennsylvania, and Gulf Coast neutrals used in the accompanying table were 94, 77, and 73 percent, respectively, of their 1930 averages, while the average prices in 1938 of Oklahoma bright stock and Pennsylvania cylinder stock were 49 and 53 percent of their 1930 averages. This is probably a result of the modern automobile requiring a lighter grade of oil than the one of a few years ago, which has changed the basic requirements for oil compounding from a major proportion of bright stocks to one of neutrals.

Average monthly refinery prices of five selected grades of lubricating oils, 1937–38, in cents per gallon [1]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1937													
Oklahoma:													
200 viscosity, No. 3 color, neutral	10.00	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.46
150–160 viscosity at 210°, bright stock, 10–25 pour test	17.00	18.25	19.30	19.50	19.50	19.50	19.00	18.50	17.25	16.25	16.00	15.25	17.94
Pennsylvania:													
200 viscosity, No. 3 color, neutral, 420–425 flash, 25 pour test	23.13	23.25	24.55	26.00	27.75	27.35	25.38	24.80	24.75	24.25	21.05	18.75	24.25
600 steam-refined, cylinder stock	13.75	15.25	17.05	17.69	17.25	16.85	14.88	14.30	13.44	10.22	8.95	7.88	13.96
Gulf Coast: 500 viscosity, No. 2½–3½ color, neutral	8.75	9.25	9.03	8.88	8.88	8.88	8.88	8.88	8.88	8.88	8.88	8.50	8.88
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	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

[1] National Petroleum News.

OTHER PRODUCTS

WAX

Domestic demand for wax decreased for the second successive year from 297,288,000 pounds in 1937 to 278,060,000 in 1938. Exports also declined from 231,723,000 to 201,919,000 pounds, making the total demand for wax in 1938, 9 percent less than it was in 1937. Production slumped 17 percent to 435,400,000 pounds, imports dropped 22 percent, and stocks on December 31 fell 11 percent to 129,340,000 pounds.

Wax prices were much weaker than is indicated by the year's average of 2.23 cents per pound compared with the 1937 average of 2.82 cents. The price per pound declined rapidly early in the year from 2.85 cents at the end of December to 1.93 cents in April, a drop of 35 percent from the high of August 1937. Subsequently it recovered to 2.40 cents and was 2.32 at the end of the year.

Comparative analyses of statistics for wax in the United States, 1937–38, by months and districts

[Thousands of pounds]

	Production		Domestic demand		Stocks			
					Crude scale		Refined	
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
By months:								
January	41,720	41,720	[2] 29,660	32,148	[2] 25,435	104,462	36,355	41,167
February	41,720	34,720	[2] 19,511	23,130	[2] 76,070	110,562	36,792	38,261
March	41,720	39,760	[2] 25,037	25,272	[2] 74,246	112,123	33,857	38,342
April	43,680	31,640	[2] 30,704	28,339	[2] 71,361	107,903	31,814	36,723
May	[2] 47,600	35,560	[2] 22,830	25,755	[2] 73,907	107,540	32,182	33,286
June	41,160	37,800	[2] 25,194	23,660	[2] 73,299	107,611	32,377	30,649
July	43,680	30,240	[2] 29,601	20,743	[2] 75,208	105,492	34,110	30,419
August	42,000	31,920	[2] 23,895	22,619	[2] 77,303	102,690	38,928	31,413
September	42,000	36,400	[2] 23,448	19,303	[2] 82,209	97,775	41,354	31,243
October	44,240	42,000	[2] 23,763	20,163	[2] 86,646	92,900	42,449	36,026
November	49,000	37,520	[2] 22,022	19,865	93,197	93,618	46,670	38,154
December	43,120	36,120	21,623	17,063	96,915	90,251	48,077	39,089
Total United States	[2] 521,640	435,400	[2] 297,288	278,060	96,915	90,251	48,077	39,089
By districts:								
East Coast	249,760	196,560			34,572	30,790	27,953	15,447
Appalachian	87,360	82,880			13,188	14,975	2,188	1,824
Indiana, Illinois, Kentucky, etc	43,120	31,640			21,639	19,076	2,610	2,674
Oklahoma, Kansas, and Missouri	33,600	30,800	(3)	(3)	2,722	1,649	1,545	1,261
Texas Inland	3,360	1,960			144	260	-	-
Texas Gulf Coast	52,640	60,200			856	774	10,078	15,489
Louisiana Gulf Coast	28,000	19,600			573	642	1,882	1,175
Arkansas and Louisiana Inland	[2] 1,680	280			-	-	585	-
Rocky Mountain	22,120	11,480			23,221	22,085	1,236	1,219
Total United States	[2] 521,640	435,400	[2] 297,288	278,060	96,915	90,251	48,077	39,089

[1] Subject to revision.
[2] Revised figures.
[3] Figures not available.

Average monthly refinery price of 122 to 124 white crude scale wax at Pennsylvania refineries, 1935–38, 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

[1] National Petroleum News.

Comparative analyses of statistics for petroleum coke in the United States, 1937–38, by months and districts

	Production (thousands of short tons)		Yield (percent)		Domestic demands (thousands of short tons)		Stocks (thousands of short tons)	
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
By months:								
January	102.2	126.2	0.5	0.6	104.1	107.0	384.1	389.5
February	91.6	122.0	.5	.7	88.7	83.2	379.7	418.8
March	107.2	114.0	.6	.6	80.2	61.6	403.3	468.5
April	101.8	127.0	.5	.7	79.9	62.6	411.7	522.3
May	109.6	137.8	.5	.7	104.8	84.4	339.2	561.6
June	99.6	137.0	.5	.7	74.7	114.7	390.5	574.3
July	109.6	137.6	.5	.7	96.5	89.0	380.1	609.8
August	113.0	148.4	.5	.7	95.1	94.5	375.5	650.6
September	113.4	110.8	.5	.6	117.2	127.3	360.4	622.6
October	127.0	146.8	.6	.7	141.2	88.3	329.2	653.8
November	111.2	152.8	.6	.8	69.4	104.0	366.2	678.4
December	120.4	141.8	.6	.7	[2] 101.3	101.1	378.6	707.5
Total United States	1,306.6	1,602.2	.6	.7	[2] 1,153.1	1,117.7	378.6	707.5
By districts:								
East Coast	10.4	3.8	(3)	(3)	(4)	(4)	10.0	5.3
Appalachian	24.4	20.0	.3	.2			2.6	9.2
Indiana, Illinois, Kentucky, etc.	726.8	977.8	2.2	3.0			158.0	407.4
Oklahoma, Kansas, and Missouri	236.2	213.6	1.0	1.0			21.9	31.4
Texas Inland	106.2	101.4	.7	.7			64.6	93.2
Texas Gulf Coast	112.8	141.0	.2	.2			52.4	49.8
Louisiana Gulf Coast	16.6	60.6	.2	.6			8.6	30.4
Arkansas and Louisiana Inland	2.0	1.2	(3)	(3)			.1	-------
Rocky Mountain	70.8	65.8	1.5	1.3			56.7	62.4
California	.4	17.0	(3)	(3)			3.7	18.4
Total United States	1,306.6	1,602.2	.6	.7	[2] 1,153.1	1,117.7	378.6	707.5

[1] Subject to revision.
[2] Revised figures.
[3] Less than 0.1 percent.
[4] Figures not available.

COKE

Although both domestic and export demand for coke receded in 1938, production increased from 1,306,600 short tons in 1937 to 1,602,200 in 1938 with a resultant increase in stocks of almost 100 percent—from 378,600 tons at the end of 1937 to 707,500 at the end of 1938. Domestic demand, which was 1,153,100 tons in 1937, dropped to 1,117,700 tons in 1938, and exports declined from 164,300 tons in 1937 to 155,600 in 1938.

ASPHALT AND ROAD OIL

Asphalt statistics represent one of the few branches of the oil industry that improved in 1938 over 1937. Domestic demand increased from 3,977,400 short tons to 4,460,600 in 1938. Exports increased from 45,500 tons in 1937 to 50,200 in 1938, but imports at 33,200 tons were slightly lower than in 1937. The increase of 210,400 tons in production—from 4,182,000 in 1937 to 4,392,400 in 1938—was insufficient to meet the increased demand, resulting in reducing stocks from 566,100 tons at the end of 1937 to 480,900 at the end of 1938.

Domestic demand for road oil fell from 7,954,000 barrels in 1937 to 7,775,000 in 1938. Stocks increased from 667,000 barrels at the end of 1937 to 680,000 at the end of 1938, and production declined from 8,087,000 barrels in 1937 to 7,788,000 in 1938. Detailed statistics on asphalt and road oil appear in the chapter on Asphalt and Related Bitumens.

STILL GAS

The production of still or refinery gas suffered the first significant set-back since separate statistics have been gathered for this product, the output in 1938 totaling 236,943 million cubic feet compared with 241,981 in 1937. At least part of this decline probably can be attributed to the conversion of the gas into gasoline by polymerization and it is reasonable to expect that the amount polymerized should increase in future.

Most of the still gas is employed for refinery fuel; it supplied 47 percent of the total B. t. u. used in refineries in 1937 compared with 34 percent in 1931. The proportion burned as refinery fuel declined from 98 percent in the first half of the decade to 93 percent in 1937, following the growth in sales to utility companies.

As the accompanying table shows, the Texas Gulf Coast district produced the greatest amount of any district, with Indiana-Illinois and East Coast, other districts important in cracking, following in order.

Production of still gas in the United States, 1936–38, by districts

District	1936		1937		1938 [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	30, 829	9, 288	31, 835	10, 339	27, 662	9, 188
Appalachian	8, 391	2, 172	8, 836	2, 301	8, 232	2, 187
Indiana, Illinois, Kentucky, etc	42, 770	11, 131	46, 710	12, 377	46, 797	12, 244
Oklahoma, Kansas, Missouri	24, 297	6, 212	26, 721	6, 968	21, 935	5, 775
Texas Inland	13, 668	2, 753	15, 990	3, 537	13, 881	2, 999
Texas Gulf Coast	65, 092	14, 902	70, 240	17, 893	76, 150	19, 039
Louisiana Gulf Coast	7, 156	2, 002	7, 413	1, 993	9, 176	2, 290
Arkansas and Louisiana Inland	4, 260	951	3, 894	899	2, 505	552
Rocky Mountain	5, 051	1, 244	5, 106	1, 344	4, 973	1, 227
California	24, 952	6, 391	25, 336	6, 567	25, 632	6, 909
Total United States	226, 466	57, 046	241, 981	64, 218	236, 943	62, 410

[1] Subject to revision.

MISCELLANEOUS PRODUCTS

Although the principal products of petroleum have been discussed on the foregoing pages many others are becoming increasingly more important. More than half of the production under this classification in 1937 was made up of liquefied petroleum gas (577,000 barrels), petrolatum (434,000 barrels), and absorption oil (201,000 barrels). Other products include alcohols, beautifiers, medicinal oils, lacquers, solvents, perfumes, glycerine, anaesthetics, plastics, and rubber.

The total demand for miscellaneous products declined from 2,249,000 barrels in 1937 to 1,776,000 in 1938, but exports increased from 101,000 to 112,000 barrels.

Production of miscellaneous oils, in the United States, 1936–37, by districts and classes [1]

[Thousands of barrels]

District	Petrolatum	Absorption oil	Medicinal oil	Specialties	Liquified petroleum gas	Other	Total
1936							
East Coast	150	9	122	8	421	67	777
Appalachian	167	13		11		54	245
Indiana, Illinois, Kentucky, etc	30			2	120	77	229
Oklahoma, Kansas, and Missouri	44	69				42	155
Texas Inland		65					65
Texas Gulf Coast	6			21	117	178	322
Louisiana Gulf Coast		1				25	26
Arkansas and Louisiana Inland						23	23
Rocky Mountain	2					127	129
California		42	34	6	46	49	177
Total United States	399	199	156	48	704	642	2,148
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

[1] Figures for 1938 not yet available.

WORLD PRODUCTION [4]

The world production of crude petroleum was 3 percent less in 1938 than in 1937, the first decline since the depression of 1930–32. The general decrease was due primarily to a 5-percent curtailment in the production of the United States through proration, in response to a recession in domestic demand, despite new discoveries and increased export demand. Outside the United States the situation varied from country to country, but the total output of all foreign countries was virtually unchanged. North and South America continued to furnish more than three-fourths of the world total. In Venezuela, Colombia, and Trinidad production increased; but in Peru it declined. In Mexico the sharp drop in petroleum production was due to the dislocation of the export trade following expropriation of 17 foreign-owned oil companies on March 18, 1938. The decrease in the output of Rumania may be ascribed to the progressive decline of certain older fields and comparatively little prospecting, in spite of the discovery of new horizons in the Baicoi-Liliesti-Tzintea field. In the Near East a slight decrease in the output of Iran was counterbalanced

[4] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

by small increases in the production of Iraq and Bahrein Island and new discoveries in Kuwait and Saudi Arabia. In the Far East, the production of Netherland India, of Sarawak and Brunei, and of Sakhalin increased. On the other hand, the production of British India and Burma declined from 1937 to 1938.

Determined efforts were made in countries of expanding domestic demand and insufficient domestic supply to expand their domestic production of crude petroleum. The U. S. S. R. increased its production of crude petroleum 4 percent from 1937 to 1938 but fell 13 percent below the quotas prescribed by the Five-Year Plan. Virtually all this output was consumed within the Soviet Union; less than 4 percent was exported during 1938. Germany increased its production more than one-fourth, not only by augmenting the output of the older fields but by discovering new fields and acquiring three new fields through the annexation of Austria. In Canada new discoveries in the Turner Valley field more than doubled the output of the Dominion in 1938 over 1937. In Argentina intensified drilling by the Government enterprise compensated for a decline in the output of private companies. Efforts to increase output in Poland and in Japan resulted only in unimportant increases.

Crude petroleum produced in principal countries of the world, 1934–38, in thousands of barrels

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938 [1]
North America:					
Canada	1,411	1,447	1,500	2,944	6,956
Mexico	38,172	40,241	41,028	46,907	34,794
Trinidad	10,894	11,671	13,237	15,503	17,736
United States	908,065	996,596	1,099,687	1,279,160	1,213,254
Other North America	28	47	62	33	32
Total North America	958,570	1,050,002	1,155,514	1,344,547	1,272,772
South America:					
Argentina	14,025	14,297	15,458	16,355	16,937
Bolivia	159	164	105	122	107
Colombia	17,341	17,598	18,756	20,298	22,450
Ecuador	1,637	1,732	1,951	2,161	2,246
Peru	16,314	17,067	17,593	17,457	15,839
Venezuela	136,103	148,254	154,794	186,775	187,369
Total South America	185,579	199,112	208,657	243,168	244,948
Europe:					
Albania	10	41	273	619	489
Czechoslovakia	178	133	127	122	132
France	557	541	503	502	516
Germany	2,187	2,996	3,115	3,176	4,074
Austria	28	44	50	221	366
Hungary				16	318
Italy	150	119	123	110	101
Poland	3,913	3,812	3,788	3,716	3,763
Rumania	62,438	61,773	64,188	52,709	48,366
U. S. S. R. [2]	174,986	182,386	199,055	195,155	202,290
Other Europe	3	2	1	1	1
Total Europe [2]	244,450	251,847	271,223	256,347	260,416

[1] Subject to revision.
[2] Includes fields in Russian Asia other than Sakhalin.

Crude petroleum produced in principal countries of the world, 1934–38, in thousands of barrels—Continued

Country	1934	1935	1936	1937	1938
Asia:					
Bahrein Island	285	1,265	4,645	7,762	8,298
Burma	7,279	7,181	7,588	7,848	7,572
India, British	1,922	2,038	1,978	2,162	1,420
Iran (Persia)	57,851	57,273	62,718	77,877	77,230
Iraq	7,689	27,408	30,406	31,836	32,643
Japan (including Taiwan)	1,821	2,249	2,440	2,488	2,557
Netherland India	46,529	47,171	50,025	56,724	57,481
Sakhalin	2,798	2,545	3,212	3,656	[3] 3,900
Sarawak and Brunei	5,140	5,546	5,209	6,009	7,012
Saudi Arabia			20	65	495
Total Asia [4]	131,314	152,676	168,241	196,427	198,608
Africa:					
Egypt	1,546	1,301	1,278	1,196	1,561
Other Africa	6	4	3	22	27
Total Africa	1,552	1,305	1,281	1,218	1,588
Australia and New Zealand	5	5	5	4	4
Undistributed	4	4	4	4	4
Grand total	1,521,474	1,654,951	1,804,925	2,041,715	1,978,340

[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.

UNITED STATES TRADE [5]

Imports.—In keeping with the reduction in the domestic output of crude petroleum, total imports of mineral oils, crude and refined, into continental United States were 5 percent less in 1938 than in 1937. They constituted 4 percent of the total new supply of mineral oils both in 1937 and in 1938.

Receipts of foreign crude petroleum decreased 5 percent from 1937 to 1938. Venezuela was the principal source of these receipts, supplying 85 percent of the total imports in 1937 and 90 percent in 1938. Ninety-three percent of the total imports of crude were received at Atlantic coast ports in 1937 and 92 percent in 1938 and the remainder at Gulf coast ports.

Receipts of foreign refined and semirefined oils likewise declined. Imports of fuel oils into continental United States, chiefly in bond for supplies of vessels, were 5 percent less in 1938 than in 1937. Imports of unfinished oils for further refining, both dutiable and in bond, decreased 8 percent from 1937 to 1938. Of the total imports of 25,313,000 barrels of fuel oil and topped petroleum reported for 1938 by the Bureau of Foreign and Domestic Commerce, the Netherland West Indies furnished 24,919,000, Mexico 349,000, and Canada 45,000 barrels.

[5] By A. H. Redfield, Petroleum Economics Division, Bureau of Mines.

Mineral oils, crude and refined, imported into continental United States, 1937–38, by months [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	For direct consumption	In bond
1937															
Crude petroleum	1,129	603	2,058	2,614	2,638	2,695	3,199	2,945	2,351	2,435	2,425	2,392	27,484	25,572	1,912
Refined products:															
Gasoline, finished	-------	-------	-------	-------	-------	-------	-------	1	58	-------	85	-------	144	2	142
Gasoline, unfinished	-------	-------	-------	-------	-------	-------	-------	-------	160	89	75	90	414	-------	414
Gas oil and distillate fuel oils	-------	-------	-------	1	-------	-------	-------	-------	15	-------	1	-------	17	16	1
Residual fuel oil	1,393	1,867	2,452	2,408	1,534	2,007	1,929	2,125	2,253	1,382	1,217	1,547	22,114	2,501	19,613
Lubricating oil	-------	1	-------	1	1	-------	-------	1	1	-------	1	1	7	3	4
Paraffin wax	7	8	5	5	14	10	21	13	13	10	6	20	132	130	2
Asphalt	2	27	28	7	54	16	13	4	1	17	17	2	188	188	-------
Unfinished oils, other	456	435	662	438	834	558	714	677	396	610	322	555	6,657	4,520	2,137
	2,987	2,941	5,205	5,474	5,075	5,286	5,876	5,766	5,248	4,543	4,149	4,607	57,157	32,932	24,225
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	1,674	1,331	2,008	2,050	1,623	2,252	1,632	1,618	1,943	1,534	1,571	1,849	21,085	2,904	18,181
Paraffin wax	10	8	10	9	19	11	10	10	7	5	1	3	103	102	1
Asphalt	62	7	10	9	10	13	7	16	11	9	19	11	184	184	-------
Unfinished oils, other	281	426	297	293	288	283	497	1,211	636	600	673	646	6,131	4,100	2,031
	4,217	3,655	4,894	4,188	4,021	4,751	4,765	4,669	4,250	4,841	4,623	5,369	54,243	30,151	24,092

[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 as of March 15, 1939; figures may differ slightly from those used throughout other sections of this report.

Crude petroleum imported into and exported from continental United States in 1938, by countries [1]

[Thousands of barrels]

	1938													1937 (total)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Imports:														
For direct consumption:														
Canada											1		1	
Colombia														431
Mexico	304		205		121		66	166	354	254	130		1,600	3,512
Trinidad and Tobago														180
Venezuela	1,511	1,914	1,904	1,603	1,523	1,860	2,230	1,361	1,079	1,836	1,716	2,213	20,850	21,272
	1,815	1,914	2,109	1,603	1,644	1,860	2,396	1,527	1,433	2,090	1,847	2,213	22,451	25,395
Bonded for manufacture and export:														
Mexico										258	304	320	882	
Venezuela	109	131	296	414	278	270	273	193	151	300	157	145	2,717	1,915
Total imports	1,924	2,045	2,405	2,017	1,922	2,130	2,669	1,720	1,584	2,648	2,308	2,678	26,050	27,310
Exports:														
North America:														
Canada	954	995	1,327	1,676	2,821	3,122	2,780	2,827	2,374	3,103	1,523	1,343	24,845	28,080
Cuba	79	80	81	131	80	81	152			80	63	78	905	905
Mexico	11	9	10	2	5	5	86	2	3	3	3	4	143	142
Netherland West Indies														842
South America:														
Argentina		93	101	292	97	208	100	101	99	109	97	207	1,504	1,420
Brazil											1		1	118
Europe:														
Belgium			64			164		49		72			349	447
Czechoslovakia					71								71	300
France	1,018	1,694	1,191	1,574	1,619	987	1,915	1,110	1,371	1,420	1,452	1,392	16,743	10,066
Germany	193	396		70		70		69	99	70	242	78	1,287	1,430
Italy	651	344	674	712	420	523	631	577	579	482	782	376	6,751	4,544
Malta, Gozo, and Cyprus														120
Netherlands	108		40		21	21			19	53		64	326	309
Sweden	92	155	109	101	158		108	44	30		101	32	930	363
Switzerland						280							280	
United Kingdom			56				33						89	753
Asia:														
China			166										166	
Japan	2,683	1,459	2,298	2,949	2,340	1,963	1,353	1,965	826	1,164	1,154	1,136	21,290	15,995
Kwantung	164				92		92	99	91	190	99	90	917	673
Africa: Union of South Africa				45				100				72	217	203
Other countries		103	4	1	74			60	86	34	85	11	458	418
Noncontiguous Territories														103
Total exports	5,953	5,328	6,121	7,553	7,798	7,424	7,250	7,003	5,577	6,780	5,602	4,883	77,272	67,231
Net exports	4,029	3,283	3,716	5,536	5,876	5,294	4,581	5,283	3,993	4,132	3,294	2,205	51,222	39,921

[1] Bureau of Foreign and Domestic Commerce.

Exports.—In spite of these imports the United States continued to be a petroleum-exporting country. Net exports of crude petroleum increased 28 percent—from 39,921,000 barrels in 1937 to 51,222,000 in 1938. Net outward shipments of refined products from continental United States increased 17 percent—from 75,927,000 barrels in 1937 to 88,619,000 in 1938. Exports and Territorial shipments constituted 13 percent of the total demand in 1937 and 15 percent in 1938. Although imports consisted almost entirely of crude petroleum, bunker oil, and semirefined oils for further processing, obtained from neighboring countries of North and South America, exports and Territorial shipments included not only crude petroleum but a wide variety of finished products shipped to all parts of the earth.

Exports of crude petroleum were 15 percent greater in 1938 than in 1937. More United States crude was purchased by France, Japan, Italy, and Sweden, countries in which the domestic refining of crude petroleum is encouraged by Government policy. On the other hand, Canada, the principal foreign purchaser of United States crude, took 12 percent less crude from the United States in 1938 than in 1937. Increased production of high-grade petroleum in Alberta and larger imports from Colombia were responsible for this decline. The United Kingdom likewise decreased its purchases of crude from the United States, as well as from Peru and Mexico, but took more from the Netherland West Indies, Venezuela, and Iraq. Sales of crude petroleum to Czechoslovakia, Germany, and Brazil were also less in 1938 than in 1937. Virtually no crude petroleum was shipped to the noncontiguous Territories in 1938, although 103,000 barrels were shipped to Hawaii in 1937.

Mineral oils, crude and refined, shipped from continental United States and including shipments to noncontiguous Territories, 1937–38, by months [1]

[Thousands of barrels]

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937													
Crude petroleum	3,596	3,776	3,196	4,899	6,795	6,180	6,363	7,423	6,602	6,640	6,645	5,116	67,231
Refined products:													
Motor fuel [2]	3,103	2,653	2,517	2,787	3,333	3,086	2,961	3,824	4,455	3,826	3,307	2,441	38,293
Kerosene	648	819	414	791	665	623	1,116	975	772	708	691	663	8,885
Gas oil and distillate fuel oils	2,197	1,533	1,960	2,511	2,790	2,633	3,090	3,046	2,956	2,565	2,826	2,021	30,128
Residual fuel oil	1,401	715	1,359	1,450	1,254	1,183	1,258	1,256	1,197	1,187	2,073	971	15,304
Lubricating oils	718	973	717	1,040	1,141	981	876	1,116	837	940	799	837	10,975
Paraffin wax	64	83	82	69	92	68	58	53	53	63	64	79	828
Coke	17	37	17	68	86	168	117	112	57	85	24	34	822
Asphalt	4	10	34	36	32	26	12	17	13	25	21	20	250
Miscellaneous oils	5	5	8	11	13	6	12	6	8	16	7	4	101
Total refined	8,157	6,828	7,108	8,763	9,406	8,774	9,500	10,405	10,348	9,415	9,812	7,070	105,586
Total crude and refined	11,753	10,604	10,304	13,662	16,201	14,954	15,863	17,828	16,950	16,055	16,457	12,186	172,817
1938													
Crude petroleum	5,953	5,328	6,121	7,553	7,798	7,424	7,250	7,003	5,577	6,780	5,602	4,884	77,273
Refined products:													
Motor fuel [2]	3,087	3,930	3,562	4,473	4,577	4,283	4,189	4,829	3,527	4,525	3,697	5,420	50,099
Kerosene	837	687	541	812	779	403	219	603	813	683	324	803	7,504
Gas oil and distillate fuel oils	2,256	2,151	2,810	2,687	2,561	2,980	2,897	2,614	2,427	1,574	2,269	2,412	29,638
Residual fuel oil	869	911	1,521	1,473	1,690	1,613	1,790	1,723	1,680	1,644	1,270	1,737	17,921
Lubricating oils	819	800	655	860	901	913	708	800	852	715	702	676	9,401
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	18	34	30	24	22	16	23	11	27	24	19	30	278
Miscellaneous oils	13	5	15	4	14	10	7	5	15	3	4	17	112
Total refined	7,982	8,604	9,203	10,427	10,682	10,336	9,951	10,699	9,485	9,388	8,460	11,233	116,450
Total crude and refined	13,935	13,932	15,324	17,980	18,480	17,760	17,201	17,702	15,062	16,168	14,062	16,117	193,723

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce as of March 15, 1939, figures may differ slightly from those used throughout other sections of this report.
[2] Includes benzol and natural gasoline.

Europe was still the principal external market for American refined oils, taking 40 percent of the motor fuel, kerosene, gas oil and fuel oil, and lubricating oils shipped from continental United States in 1937 and 47 percent in 1938. In spite of increased production of crude petroleum, of the intensive cultivation of substitute motor fuels, and of determined efforts to stimulate the refining of petroleum, Europe remains the major importing area for refined oils in international trade. Although the Netherland West Indies, Rumania, Iran, and Netherland India are rival sources of supply, the United States continued to supply in 1938 about one-sixth of the growing European requirements for refined mineral oils and about one-fourth of the European requirements if the exports of crude petroleum to be processed in European refineries are included.

Exports and Territorial shipments of motor fuel (including refinery gasoline, natural gasoline, naphthas and solvents, and benzol) showed the largest proportional increase of all forms of petroleum shipped from continental United States—a 31 percent advance in 1938 from 1937. The principal increases were in exports to northern and western Europe and to the Netherland West Indies, presumably for reshipment to Europe. Exports to Canada likewise increased considerably. The only noteworthy decrease was in exports to Africa. As in 1937, Soviet Asia found it more convenient to purchase gasoline from the Pacific coast of the United States than to receive shipments from Batum.

As in 1937, refineries of the Texas and Louisiana Gulf coast and of California furnished nearly seven-eighths of the exports and Territorial shipments of motor fuel.

Major petroleum products shipped from continental United States, by countries of destination, and shipments to and exports from noncontiguous Territories, 1937–38 [1]

[Thousands of barrels, except wax, which is in thousands of pounds]

	Motor fuel [2]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]
Exports to foreign countries:										
North America:										
Canada	1,740	3,276	84	229	1,322	1,528	440	486	2,247	11,016
Cuba	739	778	(4)	------	423	1,473	112	37	2,501	2,414
Mexico	247	238	25	22	1,466	1,268	99	87	13,269	16,831
Netherland West Indies	3,629	4,852	1,294	1,209	5,279	5,111	7	12	1	------
Panama (including Canal Zone)	173	235	37	48	1,672	1,798	10	9	391	135
Other North America	278	284	136	128	734	446	50	65	6,255	6,312
	6,806	9,663	1,576	1,636	10,896	11,624	718	696	24,664	36,708
South America:										
Argentina	5	26	1	------	------	------	37	29	4,355	4,013
Brazil	1,413	1,460	523	401	69	482	277	243	2,331	1,860
Chile	174	216	23	28	2,878	2,546	58	59	2,579	3,770
Colombia	12	16	(4)	------	(4)	2	17	17	5,625	6,540
Other South America	130	172	69	29	321	195	97	112	12,892	9,805
	1,734	1,890	616	458	3,268	3,225	486	460	27,782	25,988

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, 1937–38—Continued

[Thousands of barrels, except wax, which is in thousands of pounds]

	Motor fuel [2]		Kerosene		Gas oil and fuel oil		Lubricating oil		Wax	
	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]	1937	1938 [3]
Exports to foreign countries—Con.										
Europe:										
Belgium	2, 188	1, 383	28	51	1, 579	1, 151	978	799	12, 174	15, 271
Denmark	398	660	56	496	280	715	204	205	2, 348	2, 243
Finland	129	267	20	67	------	37	16	21	1, 296	1, 236
France	2, 587	3, 825	1	9	978	240	441	529	576	1, 101
Germany	1, 179	2, 313	104	1	2, 690	4, 026	1, 232	1, 235	29, 905	4, 219
Ireland	207	177	55	20	15	16	5	6	2, 627	2, 441
Italy	595	432	94	------	721	1, 201	373	306	21, 058	22, 104
Netherlands	2, 270	2, 417	1, 094	696	2, 721	3, 065	482	192	7, 078	5, 897
Norway	206	263	161	104	398	414	36	33	1, 268	1, 052
Portugal	163	293	93	115	42	98	94	38	1, 760	1, 761
Spain	828	2, 095	------	12	301	731	37	106	1, 655	2, 018
Sweden	826	2, 390	269	421	1, 179	908	157	159	8, 412	7, 403
United Kingdom	5, 655	10, 031	1, 294	1, 555	2, 447	4, 044	2, 519	2, 459	58, 440	45, 232
Other Europe	181	205	62	90	593	334	131	114	2, 951	2, 632
	17, 412	26, 751	3, 331	3, 637	13, 944	16, 980	6, 705	6, 202	151, 548	114, 610
Asia:										
India, British (including Burma)	2	87	3	12	30	51	570	323	1, 423	1, 029
China, Hong Kong, and Kwantung	1, 213	740	1, 432	337	1, 036	619	434	163	6, 706	6, 558
Japan	1, 434	1, 479	181	1	10, 353	8, 327	444	289	143	46
Philippine Islands	770	952	412	509	734	1, 209	111	79	860	528
U. S. S. R	1, 544	1, 547	------	------	3	------	(4)	------	------	------
Other Asia	284	742	312	259	202	278	215	174	964	654
	5, 247	5, 547	2, 340	1, 118	12, 358	10, 484	1, 774	1, 028	10, 096	8, 815
Africa:										
Union of South Africa	1, 149	619	198	20	40	78	159	117	3, 890	3, 401
Other Africa	1, 320	556	269	150	960	1, 169	397	323	12, 747	11, 175
	2, 469	1, 175	467	170	1, 000	1, 247	556	440	16, 637	14, 576
Oceania:										
Australia	1, 884	1, 994	281	169	20	22	487	415	882	556
New Zealand	631	873	35	62	276	196	110	69	52	149
Other Oceania	87	65	18	12	59	54	3	2	(4)	------
	2, 602	2, 932	334	243	355	272	600	486	934	705
	36, 270	47, 958	8, 664	7, 262	41, 821	43, 832	10, 839	9, 312	231, 661	201, 402
Shipments to noncontiguous Territories:										
Alaska	218	225	9	8	1, 039	1, 090	16	17	9	5
Hawaii	1, 173	1, 264	123	147	2, 491	2, 401	97	49	27	9
Puerto Rico	677	696	109	108	104	261	26	25	22	28
Virgin Islands	18	21	4	4	5	4	1	1	2	3
	2, 086	2, 206	245	267	3, 639	3, 756	140	92	60	45
Exports from noncontiguous Territories:										
Alaska	13	12	------	------	16	16	1	1	------	------
Puerto Rico	50	53	24	25	12	13	3	2	------	------
Virgin Islands	------	------	------	1	------	------	------	------	------	------
	63	65	24	26	28	29	4	3	------	------
Total shipments from United States	38, 293	50, 099	8, 885	7, 503	45, 432	47, 559	10, 975	9, 401	231, 721	201, 447

[1] Bureau of Foreign and Domestic Commerce as of Mar. 15, 1939; figures may differ slightly from those used throughout other sections of this report.
[2] Includes natural gasoline, naphtha, and benzol
[3] Subject to revision.
[4] Less than 1,000 barrels.

Although the United Kingdom, Sweden, Denmark, and Canada increased their purchases of American kerosene in 1938, the failure of China, Hong Kong, Kwantung, Japan, and the Netherlands to take their customary quantities of lamp oil from the United States led to a decline of 16 percent in shipments of kerosene from continental United States from 1937 to 1938. Kerosene sales to South America, to Africa, and to Australia were also appreciably less in 1938 than in 1937.

A decrease of 2.5 percent in exports of gas oil and distillate fuel oils (from 29,011,000 barrels in 1937 to 28,296,000 in 1938) was more than counterbalanced by an increase of 21 percent in exports of residual fuel oils (from 12,810,000 barrels in 1937 to 15,546,000 in 1938). However, gas oil and distillate fuel oils made up 69 percent of the exports of this group in 1937 and 65 percent in 1938. Large increases in exports of gas oil and distillate fuel oils to the United Kingdom and to Germany did not fully suffice to offset the general decline in similar exports to Europe, the Far East (except for the Philippine Islands), and Latin America (except Mexico). Increased exports of residual fuel oils to Cuba, to Italy, to the Netherlands, to Spain, and to the United Kingdom, as well as to the Philippine Islands, Panama, and Canada, were more than enough to offset declines in exports to Japan, the Canary Islands, Belgium, Mexico, and Greece.

The decline in exports of lubricating oils was general but was greatest in shipments to Europe and to Asia, the two major foreign markets. Decreased sales to the United Kingdom and to the Far East outweighed increased sales to Canada, France, Spain, and smaller foreign consumers.

Shipments of wax from continental United States were 13 percent less in 1938 than in 1937. The largest losses were in sales to Germany, the United Kingdom, Scandinavia, China, and the Union of South Africa. Nevertheless, more wax was sold to Canada, Mexico, Chile, Colombia, Belgium, and Spain in 1938 than in 1937.

Motor fuel exported and shipped to noncontiguous Territories from continental United States in 1938, by refinery districts and months [1]

[Thousands of barrels]

Refinery district	January	February	March	April	May	June
East Coast	71	70	233	228	128	114
Appalachian	12	12	15	20	22	10
Indiana, Illinois, Kentucky, etc	11	12	13	9	10	9
Texas Inland	20	304	99	246	326	155
Texas Gulf Coast	1,820	2,296	2,042	2,326	2,342	2,600
Louisiana Gulf Coast	216	161	27	292	131	133
Rocky Mountain	15	13	21	33	42	40
California	922	1,062	1,112	1,319	1,576	1,222
Total United States	3,087	3,930	3,562	4,473	4,577	4,283

Refinery district	July	August	September	October	November	December	Total
East Coast	94	38	230	129	47	132	1,514
Appalachian	15	14	31	35	45	55	286
Indiana, Illinois, Kentucky, etc	15	15	19	22	20	13	168
Texas Inland	191	431	248	299	284	410	3,013
Texas Gulf Coast	2,218	2,464	1,784	2,442	2,145	2,829	27,308
Louisiana Gulf Coast	248	242	209	292	344	166	2,461
Rocky Mountain	39	50	50	37	28	21	389
California	1,369	1,575	956	1,269	784	1,794	14,960
Total United States	4,189	4,829	3,527	4,525	3,697	5,420	50,099

[1] Compiled from data of Bureau of Foreign and Domestic Commerce as of March 15, 1939; figures may differ slightly from those used throughout other sections of this report.

Intercoastal shipments.—The 9-percent reduction in runs to stills in East Coast refineries was complemented by a 12-percent decrease in their receipts of crude petroleum by tanker from Gulf coast ports from 1937 to 1938. These receipts were equivalent to 86 percent of the total crude petroleum run to stills in East Coast refineries in 1937 and 83 percent in 1938. Receipts of all types of refined products on the East coast from Gulf coast ports increased 3 percent from 1937 to 1938.

Shipments of mineral oils from California to Atlantic ports of the United States by way of the Panama Canal decreased 9 percent from 1937 to 1938. The only increases in these shipments were in crude petroleum and in residual fuel oils. Nevertheless shipments from California made only an insignificant contribution to the mineral oils, crude and refined, available for consumption in the East Coast area.

Mineral oils, crude and refined, shipped from Gulf coast to East coast ports of the United States, 1937–38 [1]

[Thousands of barrels]

	1938						
	January	February	March	April	May	June	July
Crude petroleum	13,985	12,761	13,054	12,053	11,893	11,430	12,345
Gasoline	8,119	6,100	8,689	8,681	9,734	8,997	9,188
Kerosene	2,112	1,935	1,835	1,225	1,031	759	1,281
Gas oil and distillate fuel oils	3,185	3,761	2,667	1,864	1,647	1,510	1,651
Residual fuel oils	5,793	5,016	6,315	4,297	3,627	3,390	4,217
Lubricating oils	206	265	198	240	284	250	439
Miscellaneous oils	3	19	24	138	58	70	67
	33,403	29,857	32,782	28,498	28,274	26,406	29,188
	1938—Continued						1937 (total)
	August	September	October	November	December	Total	
Crude petroleum	12,153	12,775	11,891	12,916	13,460	150,716	170,776
Gasoline	9,217	8,964	9,372	9,371	8,604	105,036	104,127
Kerosene	1,609	1,530	2,029	1,753	2,816	19,915	18,330
Gas oil and distillate fuel oils	2,089	2,063	2,447	2,503	3,800	29,187	27,452
Residual fuel oils	4,452	3,595	4,675	4,527	7,083	56,987	56,891
Lubricating oils	489	661	313	471	635	4,451	3,186
Miscellaneous oils	5	8	16	15	71	494	263
	30,014	29,596	30,743	31,556	36,469	366,786	381,025

[1] Petroleum Conservation Division, U. S. Department of the Interior.

Mineral oils, crude and refined, shipped from California to East coast ports of the United States, 1937–38

[Thousands of barrels]

	1938													1937 (total)
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	
Crude petroleum	-----	----	70	70	62	143	149	209	74	75	71	-----	923	121
Gasoline	266	81	204	390	430	361	330	240	202	160	246	55	2,965	4,144
Kerosene	61	----	72	67	-----	-----	-----	73	-----	77	-----	-----	350	476
Gas oil and distillate fuel oils	179	----	-----	-----	-----	-----	-----	-----	-----	-----	73	69	321	726
Residual fuel oils	-----	----	-----	-----	-----	-----	-----	-----	-----	59	71	208	338	-----
Asphalt and road oils	73	----	73	63	138	-----	72	-----	71	-----	1	-----	491	415
Miscellaneous oils	1	1	4	3	9	1	4	-----	2	5	2	1	33	49
	580	82	423	593	639	505	555	522	349	376	464	333	5,421	[1] 5,931

[1] Revised figures; miscellaneous oils in July revised to 79 (Minerals Yearbook, 1938, p. 905).

NATURAL GAS [1]

By F. S. Lott and G. R. Hopkins [2]

SUMMARY OUTLINE

The natural-gas industry experienced a moderate shrinkage in demand in 1938 after 4 years of rapid recovery from the depression low of 1933. Total marketed production had increased 55 percent, from 1,555,000,000,000 cubic feet in 1933 to 2,408,000,000,000 in 1937. However, because of generally adverse business conditions in 1938, marketed production is estimated to have declined to 2,263,000,000,000 cubic feet, or 6 percent below 1937.

Capital expenditures in the production and transportation branches of the industry were much lower than in 1937, as existing facilities were generally adequate for the requirements of current markets. Since the period, 1928–32, when many long-distance gas lines were constructed, managements have emphasized expanding the volume to utilize excess capacity and improving load factors, but at profitable rates. There appear to have been two restraining influences in the last 2 or 3 years upon the extension of pipe lines to new markets. One is the activity in many localities of groups sponsoring competing fuels. The other is the stagnation of capital markets for durable goods, which has almost eliminated public financing as a means of raising money for new gas enterprises.

Estimated consumption of natural gas in the United States was 2,261,285,000,000 cubic feet in 1938, a decrease of 6 percent from the 1937 total of 2,403,041,000,000 cubic feet. The average value at points of consumption is estimated to have increased in 1938 to about 22.1 cents per thousand cubic feet from 22.0 cents in 1937, owing to gains in domestic and commercial values that more than balanced a decline in the average value of gas used for all industrial purposes. In recent years domestic and commercial demand has grown more in States where average sales values exceed the national average than it has in States with below-average rates. This trend is due to the development of important new markets remote from major gas-producing areas and has caused the average value of gas used by these groups of

[1] Data for 1938 are prelimary; detailed statistics with final revisions will be released later.
[2] Tables compiled by H. Backus, Petroleum Economics Division, Bureau of Mines.

consumers to be sustained in spite of generally declining rates in nearly all consuming areas. The total value at points of consumption of natural gas used in the United States dropped 5 percent in 1938 to about $500,000,000 from $527,529,000 in 1937.

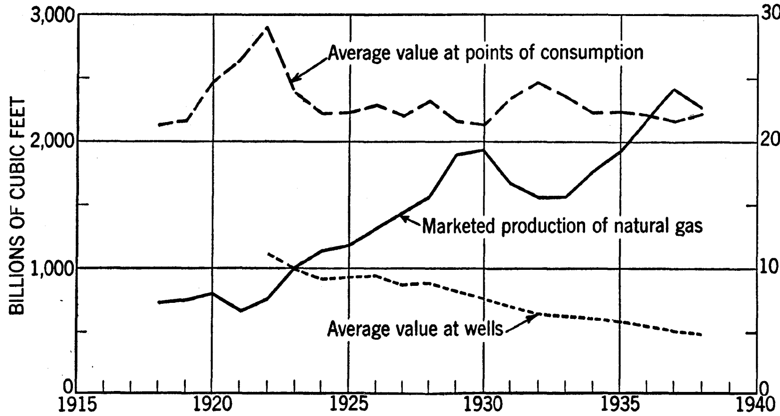

FIGURE 1.—Production and value of natural gas, 1918–38.

As shown in figure 1, the average value of natural gas at the wells is estimated to have decreased from 5.1 cents per thousand cubic feet in 1937 to 4.9 cents in 1938 and the total value from $123,457,000 to about $111,000,000, or 10 percent.

Summary of statistics for natural gas in the United States, 1933–38

	1933	1934	1935	1936	1937	1938 [1]
Marketed production:						
California......millions of cubic feet..	259, 799	268, 122	284, 109	320, 406	329, 769	315, 000
Louisiana....................do....	197, 826	225, 713	249, 450	290, 151	315, 301	280, 000
Oklahoma....................do....	245, 759	254, 457	274, 313	280, 481	296, 260	260, 000
Texas.........................do....	475, 691	602, 976	642, 366	734, 561	854, 561	845, 000
West Virginia................do....	100, 653	109, 161	115, 772	138, 076	149, 084	132, 000
Other States.................do....	275, 746	310, 292	350, 585	404, 127	462, 645	431, 000
Total production............do....	1, 555, 474	1, 770, 721	1, 916, 595	2, 167, 802	2, 407, 620	2, 263, 000
Exports:						
To Canada....................do....	69	73	73	84	78	90
To Mexico....................do....	2, 089	5, 728	6, 727	7, 352	4, 790	2, 000
Imports from Canada..............do....	83	68	106	152	289	375
Consumption:						
Domestic.......................do....	283, 197	288, 236	313, 498	343, 346	371, 844	362, 000
Commercial....................do....	85, 577	91, 261	100, 187	111, 623	117, 390	114, 000
Industrial:						
Field...........................do....	491, 159	554, 542	580, 414	618, 468	651, 320	620, 000
Carbon-black plants............do....	190, 081	229, 933	241, 589	283, 421	341, 085	325, 000
Petroleum refineries...........do....	66, 333	79, 965	80, 175	93, 183	113, 005	122, 000
Electric public-utility power plants [2] millions of cubic feet..	102, 601	127, 896	125, 239	156, 080	170, 567	170, 688
Portland-cement plants [3].......do....	22, 001	27, 331	26, 752	36, 923	40, 450	37, 336
Other industrial...............do....	312, 450	365, 824	442, 047	517, 474	597, 380	510, 261
Total consumption.............do....	1, 553, 399	1, 764, 988	1, 909, 901	2, 160, 518	2, 403, 041	2, 261, 285
Domestic..................percent..	18	16	17	16	15	16
Commercial....................do....	6	5	5	5	5	5
Industrial.....................do....	76	79	78	79	80	79

[1] Subject to revision.
[2] Federal Power Commission.
[3] Chapters on Cement in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.

Summary of statistics for natural gas in the United States, 1933–38—Continued

	1933	1934	1935	1936	1937	1938
Number of consumers:						
Domestic..................thousands..	6,691	6,984	7,391	8,017	8,348	(4)
Commercial....................do....	541	582	613	657	680	(4)
Industrial [5]....................do....	30	31	36	39	39	(4)
Number of producing gas wells............	53,660	54,130	53,790	[6] 54,500	55,370	(4)
Value (at wells) of gas produced:						
Total............thousands of dollars..	97,096	106,438	110,402	119,193	123,457	110,887
Average per M cubic feet.......cents..	6.2	6.0	5.8	5.5	5.1	4.9
Value (at point of consumption) of gas consumed:						
Domestic........thousands of dollars..	209,699	215,029	233,940	251,617	273,577	267,880
Commercial....................do....	42,582	45,287	49,386	53,693	57,161	55,860
Industrial......................do....	115,838	133,941	144,748	170,129	196,791	176,748
Total value....................do....	368,119	394,257	428,074	475,439	527,529	500,488
Average per M cubic feet:						
Domestic......................cents..	74.0	74.6	74.6	73.3	73.6	74.0
Commercial....................do....	49.8	49.6	49.3	48.1	48.7	49.0
Industrial......................do....	9.8	9.7	9.7	10.0	10.3	9.9
Domestic and commercial........do....	68.4	68.6	68.5	67.1	67.6	68.0
Domestic, commercial, and industrial cents..	23.7	22.3	22.4	22.0	22.0	22.1
Treated for natural gasoline:						
Quantity........millions of cubic feet..	1,551,464	1,776,172	1,822,000	1,815,000	2,108,800	2,115,000
Percent of total consumption..........	100	[7] 101	95	84	88	94

[4] Figures not yet available.
[5] Exclusive of oil- and gas-field operators.
[6] Revised figures.
[7] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.

Exports of natural gas to Mexico reached a peak of 7,350,000,000 cubic feet in 1936 but declined sharply to an estimated total of 2,000,000,000 in 1938. The Mexican Government requires the use of increasing percentages of gas produced in Mexico, when available, hence production developed south of the Rio Grande River has been replacing large quantities of gas formerly produced in Texas and piped across the international boundary. Exports to Canada of natural gas (mixed with manufactured gas) rose 15 percent in 1938 to 90,000,000 cubic feet; imports from Canada, which come from a single well on the Imperial dome north of Montana, increased to about 375,000,000 cubic feet in 1938 from 289,000,000 in 1937.

LEGISLATION

A Federal law to regulate interstate transportation of natural gas was passed by Congress and approved on June 21, 1938. It marks the entrance of the Federal Government into the field of gas distribution as a supervisory agency. The Federal Power Commission has the responsibility of administering the act, whose purpose is to supplement the regulatory functions of State and municipal authorities. Heretofore, geographical boundaries have limited the regulatory powers of State and local governments.

The law provides for determination and enforcement of "fair" charges by the pipe-line companies for interstate transportation of natural gas and of reasonable wholesale rates for the sale of gas at "city gates." The Commission also has power to control the construction and abandonment of all interstate gas lines, to prescribe uniform systems of accounts, and to license private parties to export gas to foreign countries.

Several important cases are now pending before the Commission relevant to its jurisdiction over construction of new gas lines and rates.

EMPLOYMENT AND PRODUCTIVITY

The following table is not comparable with a similar table published in the Minerals Yearbook 1938, page 910. Labor employed is expressed in man-hours rather than in number of wage earners. This method affords a more accurate measure of labor effort, because many of the men who operate gas wells work on a part-time basis. In the former table natural-gas production represented the gas marketed from both gas and oil wells. Information is now available on which an approximate separation of the two types of production can be made. Therefore the current table includes the gas produced from gas wells only, from which the relationship between the volume of output and the amount of labor required at gas wells is obtained directly.

Employment at gas wells, natural gas produced from gas wells, and average output per man-hour in the United States, 1936–37, 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)	
	1936	1937	1936	1937	1936	1937	1936	1937
Arkansas	37	35	82	73	3,950	5,700	48.2	78.1
California	9	18	18	36	8,000	14,000	444.4	388.9
Colorado	7	9	16	19	3,600	3,050	225.0	160.5
Illinois	6	9	11	15	40	30	3.6	2.0
Indiana	102	97	135	164	2,350	1,700	17.4	10.4
Kansas	438	566	805	1,062	54,000	57,000	67.1	53.7
Kentucky	433	400	687	775	44,000	55,500	64.0	71.6
Louisiana	235	230	438	411	270,000	290,000	616.4	705.6
Michigan	52	60	78	109	5,200	7,900	66.7	72.5
Montana	89	104	188	240	23,100	24,600	122.9	102.5
New Mexico	7	10	15	22	18,400	26,000	1,226.7	1,181.8
New York	397	530	745	989	13,400	21,900	18.0	22.1
Ohio	1,209	1,030	2,092	1,894	46,800	42,300	22.4	22.3
Oklahoma	473	530	838	965	113,000	112,000	134.8	116.1
Pennsylvania	2,182	2,220	4,452	4,413	108,000	113,200	24.3	25.7
Texas	477	450	913	837	600,000	650,000	657.2	776.6
West Virginia	2,144	2,700	4,538	5,100	132,000	148,500	29.1	29.1
Wyoming	28	35	48	55	24,000	23,000	500.0	418.2
Other States [1]	35	40	61	66	13,755	17,400	225.5	263.6
Total United States	8,360	9,073	16,160	17,245	1,483,595	1,613,780	91.8	93.6

[1] Mississippi, Missouri, South Dakota, Tennessee, Utah, and Washington.

Employment at gas wells in the older developed areas is stable under ordinary conditions. Total employment (man-hours) was 7 percent greater in 1937 than in 1936, but most of the gain occurred in West Virginia and Kansas where many new gas wells were drilled and connected to pipe lines. Employment in "dry"-gas fields in California, although small, increased 100 percent in 1937 over 1936 as a result of the growing volume of production from several recently developed fields.

It will be noted that the productivity of labor varies widely in different producing States. From a long-term standpoint the controlling factor in cost of labor per unit volume produced is the character of the production. Of course, changes in labor productivity in successive years are influenced by many variable factors, chief among which is probably the current demand for gas. Significant trends in labor productivity cannot be inferred from the data presented until such figures are available for a period of several years.

GROSS PRODUCTION

The estimates of gross production of natural gas in 1936 and 1937, shown in the following table, have been compiled in a manner similar to those for 1935 published in the Minerals Yearbook, 1937, page 1060. The total production shown for each State is the sum of the quantities of gas marketed for domestic, commercial, and industrial uses plus gas reported as used in oil-field repressuring operations, stored in natural underground reservoirs, and estimated quantities lost or wasted except waste at wellheads.

The output of gas from oil wells has increased rapidly in Kansas, Louisiana, New Mexico, and Oklahoma in recent years. Such production was about 278 billion cubic feet in 1935 and 493 billion in 1937, an increase of 77 percent. In the same period estimated losses and wastage increased nearly 300 percent, or from 51 to 202 billion cubic feet. In Texas, although casinghead-gas production increased moderately, total waste declined because of restrictions placed upon "stripper" operations.

Reports of gas used for repressuring are incomplete in some States, but a trend toward the utilization of more gas for this purpose is evident in most active areas. The total volume increased about 16 percent in 1937 over 1936. Montana and New Mexico were added to the list of States reporting repressuring operations, and increases were indicated in eight other States, Texas, Oklahoma, and Louisiana being the most conspicuous.

The storage of gas in old reservoirs for future use is a minor factor in gas distribution. However, in Kansas and Ohio it is being done on a rather large scale. Gas companies are not often so situated as to profit by this practice, as many variable aspects of supply and demand must be favorable. Therefore it does not seem to offer great promise as a conservation measure.

Part of the increased loss and waste cited above was due to greater shrinkage at gasoline-extraction plants and to more complete reporting of waste in later years. However, it is clear that even with the pronounced improvement in operating technique the exploitation of oil deposits is still wasteful of gas. If the loss in volume incident to removal of natural gasoline is excluded probably more than 80 percent of the total waste of gas in the United States is due to inefficient practices in oil production.

Gross production of natural gas in the United States, 1936–37, by States

[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]
1936							
Arkansas	3,950	6,050	10,000	8,500	773	----------	727
California	8,000	382,000	390,000	320,406	33,176	1,377	35,041
Colorado	3,600	350	3,950	3,687	----------	----------	263
Illinois	40	980	1,020	865	----------	----------	155
Indiana	2,350	150	2,500	2,241	1	----------	258
Kansas	54,000	29,400	83,400	69,178	1,220	[3] 2,100	12,561
Kentucky	44,000	4,000	48,000	43,903	850	----------	3,247
Louisiana	270,000	50,000	320,000	290,151	2,584	----------	27,265
Michigan	5,200	2,400	7,600	7,167	----------	----------	433
Mississippi	13,000	----------	13,000	11,821	----------	----------	1,179
Missouri	405	10	415	399	----------	----------	16
Montana	23,100	900	24,000	23,003	----------	----------	997
New Mexico	18,400	29,600	48,000	33,928	----------	4,225	9,847
New York	13,400	100	13,500	12,431	----------	----------	1,069
Ohio	46,800	3,200	50,000	46,994	100	1,309	1,597
Oklahoma	113,000	267,000	380,000	280,481	22,519	574	75,680
Pennsylvania	108,000	7,000	115,000	110,362	307	68	4,263
Texas	600,000	350,000	950,000	734,561	2,753	520	211,253
West Virginia	132,000	14,000	146,000	138,076	1,724	825	5,375
Wyoming	24,000	14,100	38,100	29,322	7,500	----------	1,278
Other States [4]	350	----------	350	326	----------	----------	24
	1,483,595	1,161,240	2,644,835	2,167,802	73,507	10,998	392,528
1937							
Arkansas	5,700	6,800	12,500	9,690	220	----------	2,590
California	14,000	386,000	400,000	329,769	34,120	1,589	34,522
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	48,700	105,700	83,890	1,260	[5] 5,358	19,485
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	26,000	46,000	72,000	46,337	1,087	----------	24,576
New York	21,900	100	22,000	21,325	----------	4	671
Ohio	42,300	3,200	45,500	42,783	6	[6] 5,010	1,183
Oklahoma	112,000	328,000	440,000	296,260	24,624	56	116,806
Pennsylvania	113,200	6,800	120,000	115,928	293	770	3,009
Texas	650,000	390,000	1,040,000	854,561	6,734	----------	176,666
West Virginia	148,500	14,500	163,000	149,084	3,870	868	6,227
Wyoming	23,000	16,600	39,600	31,023	7,593	----------	984
Other States [4]	2,640	----------	2,640	2,536	----------	----------	104
	1,613,780	1,325,630	2,939,410	2,407,620	84,925	13,706	433,159

[1] Marketed production plus quantities used in repressuring, stored in the ground, lost in handling, and blown to the air.
[2] Includes gas blown to the air, shrinkage at natural-gasoline plants, and transportation losses but does not include wastage at wellheads.
[3] Produced approximately as follows: 953 million cubic feet in Texas, 746 million in Oklahoma, 401 million in Kansas.
[4] South Dakota, Tennessee, Utah, and Washington.
[5] Produced approximately as follows: 2,071 million cubic feet in Texas, 2,254 million in Oklahoma, 1,033 million in Kansas.
[6] Produced approximately as follows: 2,951 million cubic feet in West Virginia, 531 million in Kentucky, 1,528 million in Ohio.

MARKETED PRODUCTION

The 6-percent decline in total marketed production in 1938 (to 2,263,000 million cubic feet from 2,407,620 million in 1937) was caused chiefly by smaller demand for most industrial uses. Output declined in all States except New York, Illinois, and New Mexico in 1938. In 1937 marketed production reached an all-time peak in Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, New Mexico, New York, and Texas.

The volume marketed from Texas fields in 1938 almost equaled that in 1937. In contrast, output declined materially in other leading producing States. Texas production has grown from 31 percent of the national total in 1933 to 37 percent in 1938. Total marketed production of the five leading States represented 82 percent of the United States total in 1933 and 81 percent in 1938.

The average value of gas at the wells increased in 1937 over 1936 in seven States, notably Louisiana, Michigan, and Wyoming. It declined substantially in Missouri, New York, Pennsylvania, and West Virginia.

Natural gas produced in the United States and delivered to consumers, 1933–37, by States, in millions of cubic feet

Year	Arkansas	California	Colorado	Illinois	Indiana	Kansas	Kentucky	Louisiana	Michigan	Mississippi	Montana	New Mexico
1933	8, 288	259, 799	2, 449	1, 631	1, 544	41, 596	31, 380	197, 826	1, 528	8, 679	14, 391	19, 148
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

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)
1933	6, 865	47, 929	245, 759	63, 579	475, 691	100, 653	25, 830	909	1, 555, 474	368, 540	23. 7
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

Natural gas produced and consumed in the United States in 1937, by States

State	Produced and delivered to consumers, including deliveries in other States						Consumed, including receipts from other States			
	Quantity		Estimated value at the 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							16, 593, 000	0. 7	$4, 163, 000	25. 1
Ariz							12, 857, 000	. 5	3, 816, 000	29. 7
Ark	9, 690, 000	0. 4	$637, 000	6. 6	$1, 984, 000	20. 5	35, 074, 000	1. 5	7, 182, 000	20. 5
Calif	329, 769, 000	13. 7	21, 699, 000	6. 6	91, 089, 000	27. 6	329, 769, 000	13. 7	91, 089, 000	27. 6
Colo	3, 186, 000	. 1	105, 000	3. 3	673, 000	21. 1	20, 816, 000	. 9	7, 032, 000	33. 8
D. C							3, 458, 000	. 1	2, 527, 000	73. 1
Fla							1, 389, 000	. 1	366, 000	26. 3
Ga							13, 893, 000	. 6	5, 546, 000	39. 9
Ill	1, 040, 000	(1)	84, 000	8. 1	533, 000	51. 3	78, 650, 000	3. 3	38, 155, 000	48. 5
Ind	1, 551, 000	. 1	227, 000	14. 6	996, 000	64. 2	23, 551, 000	1. 0	6, 821, 000	29. 0
Iowa							21, 354, 000	. 9	7, 256, 000	34. 0
Kans	83, 890, 000	3. 5	3, 565, 000	4. 2	30, 376, 000	36. 2	96, 822, 000	4. 0	20, 598, 000	21. 3
Ky	55, 719, 000	2. 3	6, 770, 000	12. 2	22, 904, 000	41. 1	18, 154, 000	. 7	7, 560, 000	41. 6
La	315, 301, 000	13. 1	10, 846, 000	3. 4	53, 908, 000	17. 1	174, 153, 000	7. 2	21, 270, 000	12. 2
Md							1, 011, 000	(1)	784, 000	77. 5
Mich	9, 080, 000	. 4	871, 000	9. 6	5, 640, 000	62. 1	24, 112, 000	1. 0	22, 583, 000	93. 7
Minn							13, 111, 000	. 5	6, 427, 000	49. 0
Miss	13, 348, 000	. 6	577, 000	4. 3	3, 041, 000	22. 8	13, 327, 000	. 6	3, 549, 000	26. 6
Mo	444, 000	(1)	38, 000	8. 6	226, 000	50. 9	46, 898, 000	2. 0	17, 550, 000	37. 4
Mont	24, 765, 000	1. 0	924, 000	3. 7	6, 667, 000	26. 9	[2] 21, 594, 000	. 9	5, 333, 000	24. 7
Nebr							17, 263, 000	. 7	6, 367, 000	36. 9
N. Mex	[3] 46, 337, 000	1. 9	714, 000	1. 5	7, 699, 000	16. 6	28, 056, 000	1. 2	3, 088, 000	11. 0
N. Y	[4] 21, 325, 000	. 9	3, 408, 000	16. 0	12, 388, 000	58. 1	50, 080, 000	2. 1	20, 299, 000	40. 5
N. Dak							1, 641, 000	. 1	620, 000	37. 8
Ohio	42, 783, 000	1. 8	6, 854, 000	16. 0	19, 967, 000	46. 7	125, 133, 000	5. 2	58, 574, 000	46. 8
Okla	296, 260, 000	12. 3	6, 127, 000	2. 1	32, 039, 000	10. 8	269, 604, 000	11. 2	22, 215, 000	8. 2
Pa	[5] 115, 928, 000	4. 8	20, 206, 000	17. 4	41, 842, 000	36. 1	119, 501, 000	5. 0	47, 537, 000	39. 8
S. Dak	10, 000	(1)	1, 000	10. 0	3, 000	30. 0	5, 519, 000	. 2	1, 892, 000	34. 3
Tenn	17, 000	(1)	1, 000	5. 9	6, 000	35. 3	13, 353, 000	. 6	4, 334, 000	32. 5
Tex	[6] 854, 561, 000	35. 5	19, 399, 000	2. 3	132, 166, 000	15. 5	706, 120, 000	29. 4	59, 751, 000	8. 5
Utah	2, 366, 000	. 1	79, 000	3. 3	471, 000	19. 9	12, 449, 000	. 5	2, 513, 000	20. 2
Va							550, 000	(1)	539, 000	98. 0
Wash	143, 000	(1)	11, 000	7. 7	100, 000	69. 9	143, 000	(1)	100, 000	69. 9
W. Va	149, 084, 000	6. 2	19, 306, 000	12. 9	58, 639, 000	39. 3	65, 395, 000	2. 7	17, 289, 000	26. 4
Wyo	31, 023, 000	1. 3	1, 008, 000	3. 2	4, 997, 000	16. 1	21, 648, 000	. 9	2, 804, 000	13. 0
Total:										
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
1936	2,167,802,000	100. 0	119, 193, 000	5. 5	476, 813, 000	22. 0	2,160,518,000	100. 0	475, 439, 000	22. 0

1 Less than 0.05 percent.
2 Includes 289,000 M cubic feet piped from Canada.
3 Includes 867,000 M cubic feet piped to Mexico.
4 Includes 29,000 M cubic feet piped to Canada.
5 Includes 49,000 M cubic feet piped to Canada.
6 Includes 3,923,000 M cubic feet piped to Mexico.

WELLS

Development was curtailed in most active sectors in 1938, total gas completions being 2,236, about 21 percent less than in 1937. The influence of slightly reduced market requirements and the existence in many important fields of developed capacity in excess of current requirements of the pipe lines lessened materially the need for new wells. Therefore, a large percentage of the gas completions during 1938 were drilled because of lease obligations or in connection with oil exploration. Active exploitation proceeded in a few highly competitive flush areas, such as the Oriskany fields near Charleston, W. Va.; Allegany and Steuben Counties, N. Y.; and the smaller new fields in Lawrence County, Ill., and Jackson County, Mo.

In Illinois, Indiana, Mississippi, Missouri, Oklahoma, and Wyoming the number of gas completions was somewhat larger in 1938 than in 1937. Declines were general elsewhere; the most conspicuous were in Kansas, Kentucky, Michigan, Texas, and West Virginia.

As shown in the accompanying table the number of gas wells producing as of December 31, 1937, was 55,370 compared with 54,500 a year earlier. Subtraction of the net increase of 870 producing wells from the 2,834 wells drilled during 1937 indicates that 1,964 gas wells were abandoned in that year.

The number of producing gas wells in Texas at the close of 1936 and 1937 has been adjusted to conform to records of the Railroad Commission of Texas.

Gas wells in the United States, 1936–38

State	Number of producing gas wells, Dec. 31, 1936	Number of gas wells drilled during 1937 [1]	Number of producing gas wells, Dec. 31, 1937	Number of gas wells drilled during 1938 [1]
Arkansas	180	6	190	3
California	40	17	60	7
Colorado	20	2	20	1
Illinois	70	3	70	23
Indiana	960	39	970	43
Kansas	2,630	357	2,500	200
Kentucky	[2] 2,380	193	[2] 2,510	91
Louisiana	1,490	148	1,600	126
Michigan	290	69	350	28
Mississippi	110	3	90	6
Missouri	130	49	150	60
Montana	360	26	380	21
New Mexico	50	27	70	19
New York	2,040	(3)	2,090	(3)
Ohio	6,350	497	6,340	433
Oklahoma	2,610	123	2,630	160
Pennsylvania	19,150	[3] 186	19,130	[3] 166
Tennessee	(2)		(2)	
Texas	[4] 2,720	425	3,260	341
Utah, Washington, and South Dakota	30	2	30	5
West Virginia	12,770	650	12,800	484
Wyoming	120	12	130	19
	[4] 54,500	2,834	55,370	2,236

[1] From Oil and Gas Journal and State sources.
[2] Tennessee included with Kentucky.
[3] New York included with Pennsylvania.
[4] Revised figures.

REVIEW OF FIELD DEVELOPMENTS, BY STATES

Arkansas.—Gross production of natural gas in Arkansas increased 65 percent to 20,557 million cubic feet in 1938 compared with 12,485 million cubic feet in 1937, according to information received from George C. Branner, State geologist.

The principal increase was in Miller County, where gas production totaled 11.1 billion cubic feet in 1938 and only 1.4 billion in 1937. Most of the Miller County gas came from new oil wells with high gas-oil ratios in the Rodessa extension. Gas output was larger in 1938 than in 1937 in Union, Sebastian, Pope, and Nevada Counties but declined substantially in Crawford, Johnson, Ouachita, and Franklin Counties. Columbia and Lafayette were added to the list of counties reporting production of natural gas in 1938.

Only three gas-well completions were reported in 1938. The No. 1 Bryan & Khilling (sec. 22, T. 8 N., R. 29 W.), in Franklin County made 1.9 million cubic feet per day from 2,600 feet. In Johnson County the No. 2 Hudson (sec. 14, T. 10 N., R. 24 W.) was completed with an initial capacity of 40 million cubic feet per day and rock pressure of 1,300 pounds from a depth of 3,401 feet. The No. 1 Raulston (sec. 12, T. 17 S., R. 14 W.), Union County, was completed with a capacity of 1.5 million cubic feet per day from 3,184 feet and a rock pressure of 1,100 pounds. In Miller County the No. B-2 Thomas (sec. 12, T. 20 S., R. 28 W.) made 12 million cubic feet per day of gas and 50 barrels of oil. Forty other completions in Miller County increased considerably the available reserves of casinghead gas. Three oil discoveries in Columbia County also added to current supplies of casinghead gas.

Gas pipe-line construction in Arkansas in 1938 was limited to one 6-inch line running from the Schuler field, Union County, to El Dorado, a distance of 18 miles.

California.—Although the marketed production of natural gas in California is estimated to have declined 4 percent in 1938 from 1937, gross production probably increased from 357 billion cubic feet in 1937 to 365 billion in 1938. Total gas processed for natural-gasoline extraction increased about 2 percent to 388 billion cubic feet, including 60 billion or more "recycled" back to the oil sands.

Production from "dry" gas fields, which represents only a small fraction of the total gas production in California, was probably somewhat larger in 1938 than in 1937. Gas wells often are shut in during the summer and allowed to produce into the pipe lines during the winter when demand for gas expands.

Drilling in the gas fields is retarded at present by the fact that productive capacity is larger than immediate needs for gas. Nine wells were completed in old fields in 1938 and 16 in 1937. The only active development was in the Rio Vista gas field, where eight of the completions were reported, extending the proved area eastward from Solano into Sacramento County. The other gas well was drilled at McDonald Island and increased the number of producers in that field to seven.

In addition, two gas discoveries were made in 1938. In Willow district, Glenn County, more than 100 miles north of San Francisco, a gas blow-out occurred at the Williard No. 1 on January 8, 1938. The reported flow of 75 million cubic feet per day wrecked the rig. A second well was drilled to 6,014 feet and, when plugged back to 2,364 feet, made 6 million cubic feet of gas. The value of the discovery is still in doubt.

The Potrero Hills No. 1, a wildcat in Solano County, was completed in December 1938 for 5 million cubic feet of gas from a depth of 3,238 feet, apparently opening up a new area for gas production.

Several oil discoveries were made in 1938 which indicated large additions to the available reserves of casinghead gas. Among these were Southeast Coalinga in Fresno County; Tupman, Coles Levee, Wasco, and Greeley (deep zone) in Kern County; and Montebello (deep zone), Wilmington, and Long Beach in Los Angeles County.

Development of gas production in recent years in the regions east and north of San Francisco Bay is providing supplies of natural gas for new market areas in the northern part of the State that hitherto have been inaccessible to natural-gas service.

Gas pipe-line construction was very small. An 8-inch line 14 miles long was built from Merced, Merced County, through Atwater to

Livingston. In the Montebello oil field 10 miles of 10-inch line were laid to carry casinghead gas.

Colorado.—The only changes in the natural-gas industry in Colorado during 1938 were in rates of production from the various fields, which generally decreased. The following data have been supplied by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo.

Total gas production was 1,487 million cubic feet, a decline of 45 percent from 1937. Output of the Hiawatha field (Colorado portion), the principal gas source within the State, was 1,301 million cubic feet, almost 50 percent less than in 1937. The Garcia field with 54 million cubic feet and the Craig field with 4 million cubic feet also produced substantially less gas in 1938. Small increases were recorded from the Thornburg and Berthoud fields, which produced 72 and 55 million cubic feet, respectively, of the total marketed output in 1938.

Gas from the Hiawatha field is consumed in Salt Lake City, Utah, and that from the other producing fields is utilized in Colorado for domestic and commercial purposes.

Waste of gas from gas fields was very small. Approximately 14 million cubic feet of gas were blown to the air from the recently discovered Wilson Creek oil field. The Garmesa, Piceance Creek, Powder Wash, and White River fields remained shut in for lack of a market.

Illinois.—The most important natural-gas development in Illinois in 1938 was the discovery of a large volume of gas in Lawrence County. Information is taken from a report by Alfred H. Bell and George V. Cohee, Illinois State Geological Survey.

Two small gas wells were drilled in 1937 in sec. 30, T. 5 N., R. 10 W., Lawrence County, producing from a Pennsylvanian sand at about 620 feet. In July 1938 the Scott Gray No. 1 (sec. 13, T. 4 N., R. 11 W.) obtained gas in the Buchanan sandstone at a depth of 1,061 feet and was completed with an initial capacity of 16 million cubic feet per day. Thirteen producing wells were drilled in the field in 1938 with an average capacity of 14 million cubic feet per well. The proved area in both fields was about 500 acres at the end of the year. Deeper potential oil- and gas-producing formations have not yet been tested. The heating value of the gas is about 950 B. t. u. per cubic foot. It comprises methane with minor amounts of ethane, carbon dioxide, and nitrogen.

The Ayers gas field in Bond County produced 23.2 million cubic feet of gas in 1938, which brought its cumulative production to 167 million cubic feet from a productive area of 325 acres. Of the 19 wells drilled in the field, 10 are still producing. The heating value of the gas is 1,050 B. t. u. per cubic foot.

A small quantity of natural gas is being produced with oil in many of the new oil fields in Illinois. Some gas is being returned to the producing sands in the Louden (Beecher City) field, and a similar project has been started in the Salem (Lake Centralia) field. Gas is used in field operations, and some is processed for extraction of natural gasoline. The excess gas is burned in flares.

A 3-inch pipe line which had been built in 1937 from sec. 30, T. 5 N., R. 10 W., Lawrence County, to Oaktown, Ind., was replaced in 1938 with a 6-inch line, and two 4-inch gathering lines were laid to the Buchanan sand field a short distance southwest.

Indiana.—Gas-well completions in Indiana in 1938 numbered 41 compared with 34 in 1937. Exploration for gas and oil was stimulated by the successful operations in Illinois, and an active leasing campaign was started in southwestern Indiana.

Two gas discoveries were reported, the No. 1 Ogle (sec. 35, T. 8 N., R. 10 W.), Sullivan County, being the more important. This well made 2 million cubic feet of gas per day from a stray sand in the Pennsylvanian series at a depth of 821 feet. The other discovery was the No. 1 Bobrink (sec. 15., T. 6 N., R. 1 W.), Dearborn County, which was completed at a depth of 450 feet with an initial capacity of 300,000 cubic feet of gas per day. The Oaktown field in Knox County was extended during 1938 by completion of new wells producing from Pennsylvanian sands.

Indiana produced 1,551 million cubic feet of natural gas in 1937 and probably a larger quantity in 1938.

A new 6-inch line was laid in 1938 to bring gas from recently developed gas fields in Lawrence County, Ill., to supplement the supply of a line in the Oaktown field.

Kansas.—Compared with 1937 there was a considerable decrease in 1938 both in total number of gas wells drilled and new pools opened in Kansas, according to a report by Raymond P. Keroher, geologist, Kansas Geological Survey. In western Kansas, 75 gas wells were completed, 25 of which also produced oil in commercial quantities. Only one of these was a discovery well. In eastern Kansas only four gas wells were reported, although many more were drilled.

The single discovery, No. 1 Young (sec. 34, T. 27 S., R. 21 W.), was completed June 13 at 5,037 feet in Mississippi lime, after having been plugged back from 5,930 feet in the Arbuckle. After treatment with 14,000 gallons of acid the well made 6 million cubic feet of gas, 48 barrels of oil, and 200 barrels of water initially. The field opened by this well, which is 50 miles from the nearest commercial oil production and the only one in Ford County, was officially named the Pleasant Valley field.

The greatest gas activity in western Kansas in 1938 was in Barber, Grant, Kearney, Reno, Rice, Stafford, and Stevens Counties. Fewer gas wells were drilled in Ellsworth, Harvey, Kingman, McPherson, Pratt, and Russell Counties.

Eight wells were added to the Medicine Lodge gas field in T. 33 S., R. 13 W., Barber County, during 1938. Their average potential was 11 million cubic feet from the Mississippi lime at depths of 4,630 to 5,045 feet.

The Hugoton field of Grant and Stevens Counties was again the most active locality in the State. Fifteen wells were completed in Stevens County with an average initial capacity of about 9 million cubic feet of gas per well, and eight were completed in Grant County with an average of 11 million cubic feet. The gas at Hugoton is obtained from rocks of the Chase and Sumner groups of Permian age at depths of about 2,600 to 2,900 feet.

In the Holcomb field (T. 25 S., R. 35 W.), Kearney County, six wells of comparable capacity and depth were completed in the same reservoir formations. Two large gas wells of 65 and 68 million cubic feet capacity were drilled in the Cunningham pool of Pratt and Kingman Counties. Production is from the Viola lime at 3,950 and 4,292 feet.

In Reno County, a 1.5-million cubic-foot well was completed in the Lerado field, and two were completed in the Yoder field with total capacity of 17.5 million cubic feet. One gas well and several oil wells with high gas-oil ratios were drilled in the Burrton field.

Four wells were drilled in the Lyons gas field (T. 20 S., R. 8 W.), Rice County, during 1938 with potentials ranging from 10 to 51 million cubic feet per day. One smaller gas well was completed in the Thurber field (T. 21 S., R. 7 W.) and one in the Stumps field (T. 17 and 18 S., R. 10 W.).

In McPherson County one well of 7 million cubic feet capacity was drilled in the Graber pool (T. 21 S., R. 2 W.), and two completions in the Ritz pool (T. 19 S., R. 1 and 2 W.) produced 30 and 29 million cubic feet of gas, respectively, with comparatively little oil.

Wells that produced gas in commercial quantities along with oil were reported as follows: One each in the Hall and Letsch fields of Russell County; one in the Kip field; and eight in the Zenith field of Stafford County. One well in the Sperling pool (T. 22 S., R. 2 W.), Harvey County, was completed in the Hunton lime at a depth of 3,249 feet with an initial production of 24 million cubic feet of gas and 164 barrels of oil.

In eastern Kansas a 5-million cubic-foot well was completed in the Penwest field (T. 31 S., R. 5 E.) and a well of the same size in the Tisdale field (T. 32 S., R. 5 E.), both in Cowley County. An important well was reported in the Andover field (T. 27 S., R. 3 E.), Butler County, with an initial capacity of 13.5 million cubic feet of gas and 204 barrels of oil. No adequate records of eastern Kansas development are compiled, but probably drilling was less active in 1938 than in 1937.

Reconditioning of the Craig-Zarah gas field in Johnson County for use as a storage reservoir was begun early in 1938 and continued most of the year.

Kentucky.—Gas development in Kentucky in 1938 was substantially less, but the volume of gas deliveries was approximately the same as in 1937, according to information in a report by C. D. Hunter, geologist, Kentucky West Virginia Gas Co., I. B. Browning, geologist and operator, and Ralph Thomas, geologist, Ashland Oil & Refining Co., all of Ashland, Ky. In eastern Kentucky not over 50 gas wells were completed, a decline of about 50 percent from 1937. Operations were curtailed because of the continued development of large volumes of Oriskany-sand gas in West Virginia and of the already developed producing capacity in eastern Kentucky which exceeds current market requirements. Average initial production of the eastern Kentucky wells was 4 to 5 hundred thousand cubic feet per day.

Gas was used for repressuring the Weir sand fields of Johnson and Magoffin Counties but only in small amounts, owing to the local scarcity of gas. The Flat Gap field, Johnson County, although nearly depleted, furnished some gas for repressuring. In Powell County the Janet field furnished some low-pressure gas to short pipe lines in Lee and Powell Counties for use as fuel and for repressuring. In a small, isolated oil field in Martin County about 150,000 cubic feet per day of casinghead gas was processed for extraction of gasoline, yielding 4 to 5 barrels daily.

In western Kentucky only 41 gas wells were drilled, distributed by counties as follows: Ohio 12, Daviess 6, Breckenridge, Grayson, and

Hancock 5 each, Henderson 4, Webster 3, and McLean 1. Total gas completions equaled only about one-third those in 1937. Because of limited marketing facilities in the area only a small part of the gas developed can be sold, hence little effort is directed toward the discovery and development of new gas-producing areas. Most gas-well completions are the result of wells started and drilled in search of oil.

No major gas pipe-line construction was reported during the year.

Louisiana.—Gas-well completions in north Louisiana in 1938 declined to 137 compared to 184 in 1937, according to a report by Cyril K. Moresi, State geologist. Of this number, 59 were combination gas and distillate wells and 4 wet gas wells. In addition, the Shreveport field, discovered in July 1938, had 6 completions which produced large volumes of gas with oil from the basal Glen Rose horizon at depths of 5,500 to 5,600 feet.

The Cotton Valley field, Webster Parish, was the most active area with 59 completions, all of which were combination wells. Eighteen gas wells were drilled in the Rodessa field, Caddo Parish, in 1938, a 51-percent decline from 1937. Total open-flow capacity of the 1938 completions was 358 million cubic feet per day.

In the Monroe gas field in northeastern Louisiana 53 wells were drilled in 1938 with a total capacity of 302 million cubic feet per day. In 1937, 89 gas wells were drilled in this field. The total number of wells capable of producing gas increased during 1938 from 1,136 to 1,182. Their open-flow capacity, however, decreased from 4,648 million to 4,310 million cubic feet per day. Of the other gas fields in northeastern Louisiana, the Richland had 75 gas wells with a total capacity of 230 million cubic feet at the end of the year, Epps had 4 wells with 107 million, and Simsboro had 3 wells with 133 million.

Other gas completions were scattered in four fields in Caddo Parish, one each in De Soto, Webster, and Bienville Parishes.

Distillate was discovered in the old Shongaloo oil and gas field, Webster Parish, in June 1938. The discovery well made 2.7 million cubic feet of gas with 279 barrels of distillate from the Cotton Valley formation at 9,010 feet. Spacing of 160 acres per well has been prescribed for future developments. The Logansport field in De Soto Parish was discovered by the Parker No. 1 in June 1938. The well produced 4.3 million cubic feet of gas with 14 barrels of distillate from the Glen Rose formation at 5,187 feet.

Proration schedules of allowable gas production are in force in the Cotton Valley, Rodessa, and Shreveport fields.

Gross production from gas wells in the State in 1938 was 260 billion cubic feet, 14 percent less than in 1937. Of the total, about 7 billion cubic feet came from southern Louisiana fields and the rest from northern fields. Production from the northeastern Louisiana fields—Monroe, Richland, and Epps—declined 18 percent in 1938 to 179 billion cubic feet. Withdrawals from Rodessa gas wells dropped in 1938 to 26.5 billion cubic feet from 56.3 billion in 1937. Cotton Valley production rose sharply from 10.4 billion cubic feet in 1937 to 20 billion in 1938.

An increase of almost 100 percent was reported in casinghead-gas production. The total was 100.8 billion cubic feet in 1938 compared with 55.8 billion in 1937. The output of northern Louisiana fields rose from 17.3 to 43.4 billion cubic feet and that of the coastal fields from 38.5 to 57.1 billions. The Rodessa field produced 34.6 billion in 1938 and only 14.3 billion in 1937. The radical changes in volume of production reported from gas wells and oil wells at Rodessa appears to be due largely to reclassification of wells. Gas production from the field totaled 70.6 billion cubic feet in 1937 and 61.2 billion in 1938. Of the northern fields, Lisbon, Cotton Valley, and Sligo were credited with substantial increases in output of casinghead gas.

Casinghead-gas production was reported from 70 coastal Louisiana fields in 1938 and 43 in 1937. Part of the indicated increase in production in 1938 is accounted for by more complete reports than previously. The most important fields in 1938, in order of output, were Tepetate, 9.5 billion cubic feet; Roanoke, 7.1; Lafitte, 6.3; English Bayou, 5.4; Iowa, 5.0; Bosco, 3.5; and Jennings, 3.0. Roanoke production increased from 132 million cubic feet in 1937 to 7,108 million cubic feet in 1938. Important increases in output also were made at English Bayou, Jennings, Lafitte, Lake Long, and Ville Platte fields.

Michigan.—Reported gas production in 1938 was 9,233 million cubic feet, about 1 percent less than in 1937, according to F. R. Frye, petroleum engineer, Michigan Department of Conservation. This total includes 1,515 million cubic feet of casinghead gas, a gain of 84 million cubic feet over 1937.

Only 27 gas wells were drilled during 1938, in contrast to 66 in 1937 and 206 in 1936, and 21 were abandoned, leaving a total of 441 producing on January 1, 1939, a net increase of 6 for the year.

New producing areas were developed in Winfield (T. 12 N., R. 9 W.) and Home Townships (T. 12 N., R. 6 W.), of Montcalm County, and Grant (T. 17 N., R. 4 W.), Lincoln (T. 18 N., R. 5 W.), and Freeman Townships (T. 18 N., R. 6 W.), of Clare County. Most of these fields were connected to existing pipe lines.

Perhaps the most interesting gas discovery was in a well drilled in sec. 32, T. 23 N., R. 5 W., Enterprise Township, Missaukee County. This well encountered about 3.7 million cubic feet of gas in the Michigan Stray sand at 1,000 to 1,008 feet. The discovery is about 30 miles from the nearest production in this sand and adds a large area of possible gas-producing territory to that already known. The gas was cemented off and the well drilled deeper.

Mississippi.—Natural-gas production in Mississippi, as reported by H. M. Morse, State oil and gas supervisor, was 14,298 million cubic feet in 1938, a slight gain over that of 1937, the previous peak year. The Jackson field supplied the entire gas output of the State in 1938, as the depleted Amory field of Monroe County did not produce after 1937.

Salt-water encroachment in the Jackson field has become a serious problem, as indicated by the sharp reduction in the number of producing gas wells from 90 on January 1, 1938, to 59 at the end of the year. Six gas wells and one dry hole were drilled in the field during 1938.

In August 1938 one of the wells caught fire and caused an estimated waste of 300 million cubic feet of gas. A temporary tax of 7.5 percent of the output was placed upon all wells to reimburse the State for money expended to extinguish the fire. General waste of gas approximated 50 million cubic feet, making a total of 350 million cubic feet of gas wasted in 1938.

The gas produced in Mississippi and sold to pipe lines was consumed approximately as follows: 25 percent for domestic purposes, 15 percent commercial, and 60 percent industrial. Over 40 percent of the State production, or 6,340 million cubic feet, was marketed through pipe lines in Alabama (28 percent), Florida (13 percent), and Louisiana (3 percent).

Nine wildcat wells were drilled in Mississippi in 1938, all of which were unproductive.

Missouri.—Drilling in Missouri increased sharply in 1938, according to a report by Frank C. Greene, geologist, Missouri Geological Survey. Of 60 gas wells completed, 56 with a total initial open-flow capacity of 52 million cubic feet were in Jackson County and 4 with 0.5 million cubic feet total capacity were in Cass County.

The most active area was the so-called Bartlesville or Sniabar "shoestring" sand field in Jackson County which was extended southeastward. It seems probable that the producing sand is at the horizon of the Burbank sand.

A new Squirrel sand gas pool was developed in secs. 30 and 31, T. 49 N., R. 32 W., Jackson County. A pipe line to take gas from this pool was completed in March 1939.

Wildcatting in Clay, Hickory, Marion, Platte, and St. Clair Counties was unsuccessful, resulting in 16 dry holes. An active leasing campaign was carried on in the "Forrest City Basin" of northern Missouri preparatory to drilling in search of new oil and gas fields.

Montana.—Drilling and production of natural gas in Montana proceeded at reduced rates in 1938, according to a report by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo. Twenty-one gas wells were completed in oil fields with a combined open flow of 122 million cubic feet per day. In 1937, 40 wells were drilled with a total capacity of 104 million cubic feet. No construction of gas transmission lines or processing plants was reported. A gas well was completed for a flow of 8 million cubic feet per day in the Moulton sand at 2,572 to 2,585 feet, 4 miles north of the Cut Bank gas area.

Gas withdrawals were 20,463 million cubic feet in 1938, about 14 percent less than in 1937. Mild winter weather and curtailed operations at copper smelters and other industrial plants contributed to the reduction in demand for gas.

Production of gas from the several fields in 1938 is shown in the accompanying table, with data on the principal uses to which it was put. About 60 percent of the total decline in output occurred at Cut Bank, and less drastic reductions were made at the Cedar Creek and Kevin-Sunburst fields. Of the less important producing areas, three (Box Elder, Dry Creek, and Whitlash) showed small increases in output and three (Bowdoin, Bowes, and Hardin) small declines.

Al gas produced, except that from the Cedar Creek field, was consumed within the State. Importations from the Rogers Imperial well in Canada continued to augment the supply for Great Falls. The quantity thus imported was about 375 million cubic feet in 1938.

Wastage of gas from gas fields is very small, being estimated at 75 million cubic feet due to losses in drilling in, testing, and faulty connections. About 10 million cubic feet of gas produced with oil escaped to the atmosphere.

New Mexico.—Sales of natural gas from the fields of southeastern New Mexico increased moderately in 1938, and the quantity processed at gasoline extraction plants gained 62 percent over 1937. Data have been furnished by E. A. Hanson, supervisor, Geological Survey, United States Department of the Interior, Roswell, N. Mex.

Source and distribution of natural gas in Montana in 1938 [1]

Field	Total production (M cubic feet)	Utilization: Domestic (M cubic feet)	Utilization: Industrial: M cubic feet	Utilization: Industrial: Consumer	Location of principal markets
Bowdoin	656,661	492,496	164,165	Steam boilers	Glasgow, Malta, Fort Peck, etc.
Bowes	526,248	263,124	263,124	Sugar refinery	Havre and Chinook.
Box Elder	276,706	207,530	69,176	do	Do.
Cedar Creek	7,181,855	(2)	(2)		(2).
Cut Bank	7,704,489	3,852,244	3,852,245	Smelters and steam boilers	Anaconda, Butte, Helena, etc.
Dry Creek	881,816	(2)	(2)		(2).
Hardin	72,329	72,329			Hardin.
Kevin-Sunburst	2,398,471	1,198,983	1,199,488	Smelters and steam boilers	Great Falls, Shelby, etc.
Whitlash	764,041	464,041	300,000	do	Great Falls, etc.
Total	20,462,616	[3] 6,550,747	[3] 5,848,198		

[1] Data supplied by H. J. Duncan, supervisor, Geological Survey, U. S. Department of the Interior.
[2] To Bozeman, Livingston, Big Timber, and intervening towns, mainly domestic.
[3] Excludes Cedar Creek and Dry Creek.

Domestic and commercial markets absorbed 24,399 million cubic feet, of which 23,700 million were produced in Lea County and the balance in Eddy County. A total of 91,800 million cubic feet was run through gasoline plants in 1938 compared with 56,500 million in 1937. Approximately 2,500 million cubic feet were used in gas-lift operations in oil wells and an additional 2,500 million for general fuel and power purposes in the fields.

Nineteen gas wells were completed in 1938 with total initial capacity of 263 million cubic feet per day; both the number and capacity declined from 1937. However, the average daily capacity per gas well increased in 1938 to 13.8 million cubic feet from 10.5 million in 1937. Most gas completions were in or near proven areas and were incidental to the search for oil. The discovery well in the new Lovington oil field of Lea County was completed as a gas well gaging approximately 4.5 million cubic feet from the Yates anhydrite zone.

Although still relatively small, interest and drilling activity have increased in the areas favorable to carbon dioxide development in the Bueyeros field, Harding County, the Wilcox field, Torrance County, and the Wagon Mound area, Mora County.

Production in northwestern New Mexico in 1938 rose 12 percent over 1937 to 2,272 million cubic feet, as reported by J. A. Frost, district engineer, Geological Survey, Farmington, N. Mex. Withdrawals from the Kutz Canyon field increased 29 percent to 1,516 million cubic feet in 1938. Output of the other two producing fields, Blanco and Ute Dome, declined moderately to 29 million and 728 million cubic feet, respectively. No wells were drilled in the district in 1938. Gas waste was small, being limited to that incidental to blowing wells during normal operations.

About 40 percent of the marketed production was used for domestic purposes and 60 percent for industrial.

New York.—As reported by C. A. Hartnagel, assistant State geologist, drilling for natural gas in 1938 was notably active in the southwestern part of the State, in Steuben and Allegany Counties, where the results of deep exploration in the preceding year or two had uncovered productive pools in the Oriskany sandstone. The gas comes from a depth of 4,000 feet or more and is found along anticlinal structures that extend northeast-southwest and probably are a part of the Appalachian folding. Within the two counties 42 wells were drilled, of which 31 were listed as producers. At the close of the year 15 wells were drilling.

Among the outstanding developments was the discovery in March 1938 of the Beach Hill pool, town of Willing, Allegany County, about 4 miles northeast of the State Line field. The new pool is situated on the Watkins (Smethport) anticline. Eleven wells were completed, of which seven were producers with total initial capacity of 79 million cubic feet per day. The Oriskany sand in this field is reached at depths of 4,740 to 5,000 feet. In the area between the Beach Hill and Greenwood pools two wells were drilled that found gas, but they were soon drowned out by salt water and abandoned.

The Woodhull field of Steuben County, discovered in 1937, continued to give good wells. Eighteen producers were drilled during 1938 with average initial capacity of 6.3 million cubic feet per well, compared with 16.6 million cubic feet per well for 20 wells completed in 1937. Six wells were drilling as the year ended.

In Troupsburg Township three wells were completed, all of which were productive. In Greenwood the only new well had to be abandoned because of salt-water intrusion. The town of West Union had two completions, one dry and the other moderately productive. East of Steuben County in Chemung County, further tests of Oriskany sandstone were conducted during 1938 but were unsuccessful. Exploration was in progress in Cayuga and Oneida Counties of central New York. The shallow Camden field, which produces from the Trenton limestone in northern Oneida County, was developed further with favorable results.

From 1934 to 1937 natural-gas production in New York more than tripled owing to development of the Oriskany sand, currently the principal source of gas in the State.

Ohio.—Both gas production and drilling in Ohio declined in 1938, according to a report by Dewitt T. Ring, geologist, Ohio Fuel Gas Co. Gas-well completions decreased 14 percent from 1937 and totaled 433—423 in central and southeast Ohio and the remaining 10 in the Lima field. The average initial capacity was 459,000 cubic feet per well; this slight increase over the 1937 average of 442,000 was due chiefly to development of larger wells in the Clinton sand.

Most of the new production came from extensions to existing productive areas rather than from important discoveries. The most active counties were Washington with 44 gas-well completions, Athens 41, Guernsey 35, Licking 32, Knox 28, Meigs 24, Stark 24, and Noble 22.

The Clinton sand yielded a total initial volume of 138 million cubic feet per day from 134 new gas wells, an average of over 1 million cubic feet per well. Continued development of Clinton sand areas in Tuscarawas County resulted in completion of 15 wells in 1938—3 in Franklin Township, 2 in Sandy, 8 in Lawrence, and 1 each in

Dover and Jefferson Townships. These wells ranged in depth from about 4,500 to 4,950 feet and had initial reservoir pressures of approximately 1,200 to 1,400 pounds. Their open-flow capacities ranged from 28,000 to 8,283,000 cubic feet and averaged only 320,000 cubic feet per well.

Five gas wells drilled in the Newburg sand, a dolomitic phase of the lower Niagara formation, had average open-flow capacities of about 1 million cubic feet per well. Two of these, in Mayfield Township, Cuyahoga County, produced 300,000 cubic feet each naturally with rock pressures of 1,120 pounds. Their open flows were increased to 2.2 million and 1.3 million cubic feet by treatment with acid.

The other outstanding sources of gas production continued to be the Berea sand and the shallower sands above it; 150 Berea wells were completed in 1938, with total initial capacity of 21 million cubic feet per day, and 106 shallow-sand wells, with a total capacity of 29 million cubic feet. Wells drilled to other producing horizons had a total open-flow capacity of about 5 million cubic feet and were as follows: Devonian shale 16, lime 13, Austinburg sand 2, Trenton lime 7.

Further prospecting of the Oriskany sand was unsuccessful in 1938. In Ohio the Oriskany is found only in the eastern part of the State, and its distribution is erratic, the formation being absent in large areas. A well in sec. 16, Sutton Township, Meigs County, penetrated less than 8 inches of Oriskany with a slight show of gas at 3,814 feet. An Oriskany test well in Washington Township, Tuscarawas County, had a show of gas and was abandoned at 3,733 feet. At the close of the year an Oriskany test well was drilling on the Miller farm, sec. 23, German Township, Harrison County, and another in West Virginia on the Burning Springs anticline a short distance south of the Ohio River, in Grant district, Pleasants County.

No new gas- or air-repressuring projects were started in 1938. Five are now in operation, and another was scheduled to start in the eastern part of the State early in 1939.

Oklahoma.—Gross production of natural gas in Oklahoma in 1938 was approximately 25 percent less than in 1937, according to records of the Oklahoma Tax Commission. The principal causes of the decline were shrinkage in industrial demand and curtailment in the use of high-pressure gas in oil-production operations in the northern part of the Oklahoma City field. The latter activities consumed large volumes of gas in 1937, most of which was dissipated to the air after forcing the oil to the surface at rapid rates. Casinghead gas production was 252 billion cubic feet in 1938, and production from gas wells was 75 billion cubic feet.

The number of gas wells completed in 1938 was about 160 compared with 123 in 1937. They were scattered over 27 counties, the most active being Caddo, Muskogee, Pontotoc, Creek, Okmulgee, Texas, Stevens, and Osage.

An important gas reserve was proved in Texas County where eight gas wells were completed at rather widely separated points. They ranged in capacity from 3 to 37.5 million cubic feet per day each. The development is an extension of the great Hugoton area of southwestern Kansas, which produces from Permian limestone at depths of 2,700 to 2,900 feet.

Active drilling in the old Cement field, Caddo County, resulted in completion of several very large gas wells. Capacities of some individual wells were reported as exceeding 100 million cubic feet per day.

The Wolfe gas field (sec. 8 T. 1 N., R. 2 E.), Murray County, was discovered in June 1938, when a well produced 34 million cubic feet of gas from the Bromide at 2,235 to 2,265 feet. Production units of 40 acres were prescribed for the area by the Corporation Commission, which also limited production rates to 25 percent of "potential" open-flow capacities. A show of oil appeared later with the gas. Other gas discoveries were reported in Muskogee, Okmulgee, Payne, Seminole, Kay, Osage, Pittsburg, and Beckham Counties.

Repressuring and maintenance of reservoir pressures in oil sands by injection of natural gas continued to spread in Oklahoma in 1938. About 125 injection wells were drilled in the northeast quarter of the State. Gas is being returned to the oil sands under large unitized blocks of leases in the South Burbank pool and the Avant district, Osage County; the Billings pool, Noble County; and the new Ramsey pool, Payne County.

In December 1938 the Osage Indian Agency notified all operators in the Burbank field that surplus casinghead gas must be returned to the oil sand.

Pennsylvania.—Production of natural gas and drilling activity in Pennsylvania declined in 1938, according to information supplied by J. G. Montgomery, Jr., superintendent and chief geologist, United Natural Gas Co., Oil City, Pa.

Completions of new shallow-sand wells during 1938 in the northwest counties declined 30 percent, all areas showing decreases except the new Sliverville sand field southwest of the Bradford oil field. Most wells in this field produced oil as well as gas. No new shallow-sand fields of importance were found.

Two Oriskany-sand discoveries were made, both in Potter County. The first, in Bingham Township, had subnormal rock pressure, indicating that it may be an eastern extension of the older Ellisburg field. The second was in Sharon Township. Developments in 1938 in the four counties in Pennsylvania that produce gas commercially from the Oriskany sand or the Onondaga lime immediately above it resulted in completion of 12 Oriskany gas wells as follows: In Beaver County two producing wells with open-flow capacity of about 3 million cubic feet each and one dry hole were drilled, making a total of five wells producing from the Oriskany sand in this pool at the end of the year. In Fayette County two producers and one dry hole were drilled, making three producing wells in this area. Capacities of gas wells in this area ranged from 2 to 3.5 million cubic feet each with a rock pressure of about 3,000 pounds and depths from 6,825 to 8,159 feet. In Potter County six producers with total capacity of 44.6 million cubic feet per day and nine dry holes were completed. Open-flow tests ranged from 1.9 to 17 million cubic feet per day and rock pressures from 555 to 1,920 pounds. In Tioga County, two producing wells and two dry holes were drilled. Open-flow capacities were 2 and 2.7 million cubic feet and rock pressures 2,090 and 590 pounds.

Twenty-one wildcat wells were drilled in 1938, of which four produced. Two were in Bingham Township and one in Sharon Township, Potter County, and one was in Brookfield Township, Tioga County. At the close of the year nine wildcat wells were drilling.

No test wells were completed to the Medina sandstone in 1938, but one was drilling to that horizon in Mercer County.

Four wells were drilled with rotary equipment to depths of 6,454 to 8,482 feet. The Lower Devonian formations have proved highly resistant to rotary bits.

Oriskany-sand production from Potter and Tioga Counties totaled about 25 billion cubic feet in 1938, a drop of 50 percent from 1937. This steep decline was caused by rapid depletion of reserves and failure to develop important new fields early in the year.

Production of gas from the shallow fields increased in 1938, partly offsetting the shrinkage in output from the deeper sands.

South Dakota.—E. P. Rothrock, State geologist, reports that no important change has taken place in the gas situation in South Dakota during 1938. The volume of production at Pierre and Fort Pierre declined slightly. Production for the year was about 9 million cubic feet. An attempt was made to have gas lines extended to cities in the James Valley as far as Aberdeen, but as yet no action has been taken.

Texas.—Data published by the Texas Railroad Commission indicate that natural-gas production in Texas reached a total of about 1,100 billion cubic feet in 1938, an increase of 11 percent over 1937. This figure includes about 45 billion cubic feet used for repressuring and recycling, 50.5 billion extraction loss at gasoline plants, and 137 billion blown to the air—increases over 1937 of 97, 6, and 50 percent, respectively. About 867.5 billion cubic feet of gas were used for other purposes in 1938 and 832.3 billion in 1937. Demand for gas in carbon-black manufacture declined 3 percent in 1938, pipe lines took 2 percent more, and reported use for plant fuel and lease operation increased 30 percent over 1937.

The rapid growth of repressuring and recycling is due largely to improved production methods in the high-pressure distillate fields. Inquiry into the behavior of the lighter hydrocarbons under varying conditions has revealed the great losses in recovery that may result from failure to maintain pressures above critical points in some types of reservoirs. The growing use of pressure-maintenance equipment should conserve large quantities of gas and increase yields of the liquid fractions.

The large increase in waste of residue gas in 1938 over 1937 is due chiefly to oil-production activity in flush areas where high gas-oil ratios are common. The volume blown to the air in the Panhandle was curtailed in the latter months of 1937 to an average of about 25 million cubic feet per day but averaged about 40 percent more in the last quarter of 1938. The greatest losses occurred in the South Texas district in connection with oil production. Gas reported as blown to the air amounted to about 6 million cubic feet per day early in 1937 in this area and to more than 140 million per day during the latter half of 1938. Losses in the Gulf Coast fields in 1938 were about double those of 1937. West Texas gas waste has averaged slightly less than 100 million cubic feet per day for the past 2 years. These data cover residue gas only. The volume of direct waste from producing leases is unknown. The situation has improved to the extent that more gasoline-extraction equipment is used in flush-oil fields to recover a part of the fuel value of the gas before blowing it to the atmosphere.

Completion of 341 gas wells was reported in Texas in 1938 compared with 425 in 1937. The Panhandle and Southwest Texas districts were the most active with 105 new wells each. North Central Texas and the Gulf Coast districts, with 43 and 36 new gas wells, respectively, were next in activity, followed by the East Central Texas with 25, West Texas with 16, East Texas border with 10, and East Texas with 1.

Two new gas areas were opened in the Panhandle—one in Gray County by the Fowler No. 1, which produced 25 million cubic feet of gas from the granite wash at 2,500 feet, and one in Sherman County by the Davis No. 1, which produced 30 million cubic feet from the same formation at 2,705 to 2,800 feet. In the Southwest Texas district the following distillate discoveries were reported: M. Valdez No. 1 at Banderia, Jim Wells County, 6,419 feet deep; Rooke No. 2 at La Rosa, Refugio County, which produced through perforations at 5,395 to 5,400 feet; and the American Rio Grande No. 1 at Weslaco, which produced from the Frio-Vicksburg sand at 8,634 to 8,642 feet, and the Lynn No. 1 at McAllen, which produced from 5,970 to 5,994 feet, both in Hidalgo County. Gas or distillate discoveries were reported in 10 other counties of the district.

In the West Texas district Tunstill No. 1 in Reeves County was completed in October 1938 with an initial capacity of 2.5 million cubic feet of gas from 3,274 to 3,310 feet. An 8-million cubic-foot well, Voth No. 1, was completed in July in Cooke County, North Central Texas district, from the Ellenburger limestone at 1,802 feet. A discovery in the Strawn formation, the Johnson No. 1, was completed in Eastland County, West Central Texas district, with an initial capacity of 2 million cubic feet per day from 1,482 to 1,488 feet.

Gas proration regulations were applied to Rodessa, also to the "sweet" and "sour" gas areas of the Panhandle field early in 1938. The proration law was attacked and upheld by a three-judge district court.

Utah.—Gas production in Utah jumped about 89 percent in 1938 over 1937 owing to increased withdrawals from the Clay Basin field, according to a report by H. J. Duncan, supervisor, Geological Survey, United States Department of the Interior. Clay Basin production, which is piped to Salt Lake City, was 3,709 million cubic feet in 1938 and 1,936 million cubic feet in 1937. The increased volume replaced part of the gas that heretofore had been produced into the same pipeline system from the Baxter Basin and Hiawatha fields, in Wyoming and Colorado, respectively. Production from the Ashley Valley field declined about 10 percent in 1938 to 44 million cubic feet; the entire output was used for domestic purposes in the vicinity.

The only gas well drilled in Utah in 1938 extended the productive limits of the Clay Basin field of Daggett County about 1 mile eastward. It was completed for 16 million cubic feet of initial capacity from the Dakota sand at 6,036 feet with a rock pressure of 2,100 pounds. There are now five gas wells in the Dakota and one in the Frontier on the Clay Basin structure.

Forty-two miles of a 52.7-mile 18-inch loop line were completed from Bigelow Hills, Wyo., to Coalville, Utah, partly paralleling the present line from Green River, Wyo., to Salt Lake City.

Very little gas was wasted or used in the field.

Washington.—Completion of four small gas wells in the Shallow field, 8 miles north of Bellingham, Whatcom County, marked the only gas development in Washington in 1938, according to information supplied by S. L. Glover, assistant supervisor of geology, Washington Department of Conservation. Depths of the wells ranged from 560 to 1,785 feet. The gas occurs in the Chuckanut formation with salt water, which requires the use of a separator at each well. Capacity of individual wells is only a few thousand cubic feet per day, but further development, it is hoped, will produce gas in commercially profitable amounts. The present production is distributed locally for domestic use.

Production from the Rattlesnake Hills field, Benton County, declined about 15 percent in 1938 to 121 million cubic feet valued at $75,488. Of the total, 8 million cubic feet were used in field operations and 111 million were sold to consumers in seven towns in the Yakima Valley.

Some prospecting for oil and gas was reported in 11 scattered counties.

The manufacture of dry ice from carbon dioxide near Klickitat, Klickitat County, continued to increase as in recent years, the 1938 production being 1,644,000 pounds valued at $50,740, from 13 million cubic feet of gas. All the natural springs have been abandoned in favor of shallow drilled wells which afford better control of production and larger volumes. One well recently completed at a depth of 70 feet produces enough gas for 3,600 pounds of dry ice per day.

West Virginia.—Drilling and pipe-line construction were considerably less in 1938 than the high level of 1937, as reported by David B. Reger, consulting geologist, Morgantown, W. Va., and R. C. Tucker, assistant State geologist. Gas-well completions totaled 504, a decline of 26 percent, but the number of successful wells in the Oriskany sand increased to 120 from 100 in 1937.

That interest in development work in West Virginia was maintained in 1938 is indicated by permits to abandon, which declined from 641 in 1937 to 570 in 1938; permits to drill, which increased from 1,034 to 1,085; and permits to deepen, which increased from 71 to 131. It is estimated that gas production in West Virginia was about 150 billion cubic feet, or approximately that of 1937.

Exploitation of the Oriskany sand continued vigorously in 1938. Important extensions were made to known producing fields, but little success attended efforts to discover new areas. In Kanawha County 120 Oriskany-sand completions were reported, of which 116 were gas wells with total open-flow capacity of 1,040 million cubic feet per day. The proved area of the three recognized pools in the county was increased to approximately 63,000 acres. The largest pool in the Elk and Poca districts, Kanawha County, was extended in 1938 into the Ripley and Washington districts of Jackson County by drilling of three gas wells in the latter districts. A wildcat well in Ravenswood district, Jackson County, gaged 337,000 cubic feet from the Oriskany with 1,600 pounds rock pressure, but completion was delayed because of lost tools. Failures in the Oriskany were drilled in the Teays Valley district, Putnam County; in the Tucker district, Wirt County; and in the Steel and Lubeck districts, Wood County. The Lubeck well showed gas in the Oriskany. Three dry wells in the Oriskany sand were drilled in Boone County, two in Jackson County, and one in Clay County.

Eight wildcat rigs were active at the close of the year in six counties.

The leading counties in gas development and the number of successful gas wells in each were: Boone 15, Braxton 10, Cabell 49, Calhoun 28, Doddridge 10, Gilmer 65, Kanawha 129, Lincoln 18, Ritchie 37, Wayne 20, and Wetzel 30. Wells completed in other sands than the Oriskany totaled 384, more than three times the number of Oriskany wells, but their initial capacity was less than a fifth that of the Oriskany wells.

A new area was opened in Barbour County by completion of a small Benson sand well north of Volga. A Clay County wildcat southeast of Villa Nova produced 510,000 cubic feet from the Webster Springs sand (upper Mississippian) at a depth of 1,708 to 1,758 feet. This sand has not heretofore been known as productive. In Wetzel County a 10-million cubic-foot well was completed in the Gordon sand north of Newdale in an area where gas has come chiefly from the shallower Maxton sand.

Considerable gas from new operations is now being moved to favorably situated old wells in Harrison, Lewis, and Taylor Counties for underground storage. A large quantity of Oriskany gas has been piped to central Ohio for storage in old Clinton-sand wells.

The price of gas in the field apparently continued the decline that has proceeded without interruption since 1931. The available supply greatly exceeds the immediate demands of present markets.

Wyoming.—Gross production of gas in Wyoming in 1938, including estimates of unmetered gas and that used for recycling and repressuring, was more than 38 billion cubic feet, about the same as in 1937, according to a report by H. J. Duncan, supervisor, Geological Survey, Casper, Wyo. Of the total, 1.4 percent was lost or wasted in field operations and 2.1 percent was lost in testing or controlling new wells at Beaver Creek, Big Piney, Dry Piney, and Muskrat.

Production of casinghead gas in the Salt Creek field was 10,010 million cubic feet in 1938, of which 6,833 million were returned to the reservoir after extraction of its gasoline content, leaving a net withdrawal from the field of 3,177 million cubic feet. Natural-gasoline production was about 26 million gallons, with an indicated extraction loss or shrinkage of 671 million cubic feet. Of the residue gas utilized above ground, 1,744 million cubic feet were consumed in field operations, 680 million used to generate electric power, and 81 million lost in distribution.

Gas production declined moderately in nearly all fields. Notable exceptions were Big Medicine Bow and Muskrat, whose output more than doubled. Withdrawals from Little Buffalo Basin and Little and Big Polecat were slightly larger. The largest producing fields and their 1938 production in millions of cubic feet were as follows: Big Sand Draw 4,174, Lance Creek 3,620, South Baxter Basin 3,460, Big Medicine Bow 3,206, Muskrat 2,210, North Baxter Basin 1,960, Elk Basin 1,614, and Little Buffalo Basin 1,523.

Fourteen gas wells were completed in 1938 in Wyoming (12 in 1937), of which 11 with an initial production of 133 million cubic feet per day were in old fields and 3 with an initial production of 43 million cubic feet were in new fields.

At Beaver Creek, Fremont County, a unitized structure, a well in sec. 3, T. 33 N., R. 96 W., was completed on April 29, 1938, with 7.8 million cubic feet of capacity and a rock pressure of 3,475 pounds from the Morrison formation at 8,230 to 8,285 feet. The situation is near a pipe line, but there is no immediate market for the gas.

A discovery well was completed on June 21, 1938, on the Oil Springs structure, Carbon County (sec. 3, T. 23 N., R. 79 W.), which produced 19.3 million cubic feet initially with a rock pressure of 1,100 pounds from the Sundance formation at 2,222 to 2,315 feet. A second well, completed in sec. 2 on December 6, had an initial open-flow capacity of 16 million cubic feet from the same horizon.

At Big Piney and Dry Piney, both in Sublette County, southwestern Wyoming, gas blow-outs that occurred during the drilling of wildcat wells indicate the possibility of gas accumulations. However, the area is sparsely populated and remote from markets. Drilling operations will continue in 1939 at both wells.

New gas reserves were discovered in the Muskrat field, Fremont County, by a well in sec. 4, T. 33 N., R. 92 W., which made 40 million cubic feet of gas from the Lakota sand at 5,306 to 5,320 feet. At Elk Basin the deepening of an old well resulted in a 73-million cubic-foot flow of gas which increased the available supply for the pipe line to Billings, Mont. Four wells drilled at Baxter Basin had a combined open-flow capacity of 15 million cubic feet per day.

The production from Lance Creek before December 16, 1937, was used mainly in a carbon-black plant, but under a unit plan effective January 1, 1938, it is now used in drilling, repressuring, and field activities. About 1 billion cubic feet of the Lance Creek output in 1938 were used in field operations, about 2.5 billion were utilized in repressuring, and 75 million cubic feet were lost or wasted. No carbon-black plants are now operating in Wyoming.

Gas wells connected to existing pipe lines are adequate for immediate needs. Increased use of natural gas may be provided through increased repressuring activities in some of the larger oil fields.

CONSUMPTION

Less natural gas was used in 1938 by all classes of consumers except petroleum refineries and electric-power plants. The decline in miscellaneous industrial consumption was sharpest, about 15 percent, and was particularly marked in the manufacturing sections of East-Central United States. Domestic consumers used 16 percent of the gas in 1938 and 15 percent in 1937. Industrial consumption took 79 and 80 percent of the total, respectively.

Natural gas consumed in the United States, 1933–37

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		
1933	6,691	541	7,232	283	86	369	51.0	68.4
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

[1] Includes consumers served with mixed gas.

Natural gas consumed in the United States, 1933–37—Continued

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			
1933	491	190	66	103	22	312	1,184	9.8	1,553	23.7
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

[2] Federal Power Commission.
[3] Chapters on Cement, in Minerals Yearbook and Statistical Appendix to Minerals Yearbook.

Natural gas consumed in the United States, 1933–37, by States, in millions of cubic feet

State	1933	1934	1935	1936	1937
Alabama	7,510	7,932	10,563	16,630	16,593
Alaska	19				
Arizona	2,513	4,729	5,603	8,232	12,857
Arkansas	22,775	25,075	26,476	30,986	35,074
California	259,799	268,122	284,109	320,406	329,769
Colorado	15,862	16,449	17,233	19,713	20,816
District of Columbia	2,046	2,640	2,707	3,104	3,458
Florida	494	554	692	1,005	1,389
Georgia	4,450	5,357	8,082	11,575	13,893
Illinois	33,341	45,084	57,319	72,516	78,650
Indiana	5,996	12,864	15,613	18,564	23,551
Iowa	11,408	16,636	19,077	20,918	21,354
Kansas	57,032	65,599	72,806	82,025	96,822
Kentucky	13,222	14,106	15,826	18,159	18,154
Louisiana	115,800	137,413	151,934	166,485	174,153
Maryland	667	752	784	915	1,011
Michigan	1,528	2,789	4,203	11,142	24,112
Minnesota	3,547	7,125	10,579	11,918	13,111
Mississippi	5,818	7,219	8,765	11,368	13,327
Missouri	27,584	29,792	33,060	40,124	46,898
Montana	[1] 12,222	[1] 12,444	[1] 16,832	[1] 19,894	[1] 21,594
Nebraska	10,293	12,789	14,310	16,780	17,263
New Mexico	13,400	15,625	18,419	19,814	28,056
New York	19,912	31,209	35,705	40,638	50,080
North Dakota	1,020	1,112	1,382	1,578	1,641
Ohio	92,762	94,998	105,896	121,381	125,133
Oklahoma	242,494	249,721	258,598	260,120	269,604
Pennsylvania	73,627	87,474	91,601	110,195	119,501
South Dakota	3,264	3,901	4,656	5,061	5,519
Tennessee	7,369	8,062	9,479	11,913	13,353
Texas	412,428	501,047	525,697	598,088	706,120
Utah	5,853	6,776	8,747	10,552	12,449
Virginia	213	292	343	447	550
Washington	111	104	138	141	143
West Virginia	46,933	52,353	53,763	57,978	65,395
Wyoming	20,087	16,844	18,904	20,153	21,648
Total United States	1,553,399	1,764,988	1,909,901	2,160,518	2,403,041

[1] Includes natural gas piped from Canada.

In 1937 increased consumption of natural gas was general in all parts of the country. The sharpest gains over 1936 were in Arizona, Arkansas, Michigan, New Mexico, and Texas.

Domestic consumers of natural gas numbered 8,348,000 and commercial consumers 680,000 at the end of 1937. These totals were

4.1 and 3.5 percent larger than at the end of 1936. Further growth doubtless took place in 1938.

Treated for natural gasoline.—The volume of natural gas processed at natural-gasoline plants in 1938 was about 2,115 billion cubic feet, estimated on the basis of an average recovery of 1 gallon per thousand cubic feet. In 1937, 2,108.8 billion cubic feet were processed, equal to 88 percent of total consumption. The volume processed in 1938 was 94 percent of the consumption. The gain in percentage reflected the efforts of natural-gasoline manufacturers to increase their supplies.

Pronounced increases in volume handled in 1937 over 1936 in California, New Mexico, and Texas continued through 1938. In Oklahoma and Louisiana, however, the volume was considerably less in 1938 than in 1937.

Natural gas treated at natural-gasoline plants in the United States, 1933–37, by States

[Millions of cubic feet]

State	1933	1934	1935	1936	1937
Alaska	20				
Arkansas	4, 949	3, 250	3, 371	2, 955	4, 031
California	326, 016	325, 629	310, 016	372, 118	381, 568
Colorado	547	511	222	223	153
Illinois	1, 701	1, 512	1, 076	971	1, 027
Kansas	52, 939	69, 859	87, 669	106, 230	153, 416
Kentucky	22, 244	21, 704	29, 772	35, 493	34, 981
Louisiana	80, 891	70, 534	81, 868	115, 606	144, 474
Michigan	444	410	1, 755	1, 419	1, 381
Montana	4, 358	4, 114	6, 382	8, 238	9, 062
New Mexico	10, 399	11, 904	11, 786	29, 489	61, 625
New York	406	375	27	22	50
Ohio	21, 901	25, 100	29, 622	33, 103	33, 625
Oklahoma	351, 989	299, 183	260, 757	255, 433	338, 007
Pennsylvania	31, 810	29, 346	33, 348	34, 168	31, 508
Texas	532, 148	787, 078	828, 570	673, 483	754, 696
West Virginia	90, 072	108, 097	118, 789	128, 488	140, 512
Wyoming	18, 630	17, 566	16, 970	17, 561	18, 684
	1, 551, 464	1, 776, 172	1, 822, 000	1, 815, 000	2, 108, 800
Percent of total consumption	100	[1] 101	95	84	88

[1] Exceeds 100 percent, as part of the natural gas treated for natural gasoline is blown to the air and not included in total consumption.

Domestic and commercial.—Domestic use of natural gas fell about 3 percent in 1938. Demand is estimated at 362 billion cubic feet compared with 372 billion in 1937. As the number of domestic meters in use was greater in 1938 than in 1937, the average consumption per meter declined more abruptly than did the total consumption. In a few States, notably California, Michigan, and Indiana, volume of domestic sales increased. The estimated average value of gas purchased by domestic consumers in 1938 was 74.0 cents per thousand cubic feet, slightly above the comparable figure for 1937 of 73.6 cents. The total value of domestic sales was about $267,880,000 in 1938 compared with $273,577,000 in 1937.

Commercial consumption declined about 3 percent in 1938 to 114 billion cubic feet. The average value at points of consumption is estimated to have advanced to 49.0 cents per thousand cubic feet from the 1937 average of 48.7 cents, indicating a total value in 1938 of $55,860,000.

The weather in the United States in 1938 was unseasonably warm during the months of heavy gas consumption. This factor undoubtedly reduced somewhat the demand from domestic and commercial customers.

Domestic and commercial consumption of natural gas in the United States in 1937, 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	26,210	1,188,000	$1,341,000	112.9	3,280	689,000	$327,000	47.5	29,490	1,877,000	$1,668,000	88.9
Arizona	25,580	679,000	1,123,000	165.4	2,660	609,000	364,000	59.8	28,240	1,288,000	1,487,000	115.5
Arkansas	64,260	5,678,000	3,110,000	54.8	10,320	3,177,000	1,112,000	35.0	74,580	8,855,000	4,222,000	47.7
California	1,483,510	65,758,000	55,447,000	84.3	89,750	15,951,000	9,041,000	56.7	1,573,260	81,709,000	64,488,000	78.9
Colorado	92,240	4,927,000	3,927,000	79.7	8,580	1,558,000	898,000	57.6	100,820	6,485,000	4,825,000	74.4
District of Columbia	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Florida	3,460	108,000	152,000	140.7	310	39,000	31,000	79.5	3,770	147,000	183,000	124.5
Georgia	77,380	3,925,000	3,491,000	88.9	5,730	1,662,000	647,000	38.9	83,110	5,587,000	4,138,000	74.1
Illinois	1,169,650	18,408,000	23,229,000	126.2	61,360	4,455,000	3,838,000	86.2	1,231,010	22,863,000	27,067,000	118.4
Indiana	115,590	1,882,000	1,945,000	103.3	5,710	278,000	253,000	91.0	121,300	2,160,000	2,198,000	101.8
Iowa	109,910	3,741,000	3,807,000	101.8	8,150	1,377,000	815,000	59.2	118,060	5,118,000	4,622,000	90.3
Kansas	197,460	15,761,000	9,492,000	60.2	23,680	8,767,000	2,931,000	33.4	221,140	24,528,000	12,423,000	50.6
Kentucky	156,690	7,981,000	4,451,000	55.8	18,870	2,385,000	1,179,000	49.4	175,560	10,366,000	5,630,000	54.3
Louisiana	157,400	8,291,000	5,806,000	70.0	19,300	4,270,000	1,804,000	42.2	176,700	12,561,000	7,610,000	60.6
Maryland	[2] 191,020	[2] 3,975,000	[2] 3,157,000	[2] 79.4	[2] 8,990	[2] 487,000	[2] 350,000	[2] 71.9	[2] 200,010	[2] 4,462,000	[2] 3,507,000	[2] 78.6
Michigan	515,950	14,181,000	16,715,000	117.9	20,530	1,853,000	2,070,000	111.7	536,480	16,034,000	18,785,000	117.2
Minnesota	135,650	3,675,000	4,084,000	111.1	7,420	1,309,000	782,000	59.7	143,070	4,984,000	4,866,000	97.6
Mississippi	35,460	2,692,000	1,799,000	66.8	6,440	1,922,000	618,000	32.2	41,900	4,614,000	2,417,000	52.4
Missouri	362,220	11,011,000	9,529,000	86.5	33,940	4,002,000	2,498,000	62.4	396,160	15,013,000	12,027,000	80.1
Montana	34,000	5,634,000	2,621,000	46.5	4,490	3,804,000	1,114,000	29.3	38,490	9,438,000	3,735,000	39.6
Nebraska	111,120	4,769,000	3,634,000	76.2	7,390	1,423,000	786,000	55.2	118,510	6,192,000	4,420,000	71.4
New Mexico	17,550	1,334,000	969,000	72.6	2,350	1,009,000	393,000	38.9	19,900	2,343,000	1,362,000	58.1
New York	395,130	14,678,000	12,142,000	82.7	33,020	2,621,000	1,991,000	76.0	428,150	17,299,000	14,133,000	81.7
North Dakota	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	1,156,680	56,738,000	33,673,000	59.3	111,450	11,512,000	6,442,000	56.0	1,268,130	68,250,000	40,115,000	58.8
Oklahoma	225,270	20,274,000	9,281,000	45.8	29,920	8,527,000	2,799,000	32.8	255,190	28,801,000	12,080,000	41.9
Pennsylvania	651,310	35,609,000	21,880,000	61.4	55,900	8,198,000	4,545,000	55.4	707,210	43,807,000	26,425,000	60.3
South Dakota	14,370	1,157,000	882,000	76.2	1,720	1,149,000	460,000	40.0	16,090	2,306,000	1,342,000	58.2
Tennessee	39,920	2,294,000	1,971,000	85.9	5,290	1,865,000	755,000	40.5	45,210	4,159,000	2,726,000	65.5
Texas	560,800	31,205,000	24,196,000	77.5	70,480	15,102,000	5,911,000	39.1	631,280	46,307,000	30,107,000	65.0
Utah	[3] 28,400	[3] 2,716,000	[3] 1,724,000	[3] 63.5	[3] 1,510	[3] 1,223,000	[3] 424,000	[3] 34.7	[3] 29,910	[3] 3,939,000	[3] 2,148,000	[3] 54.5
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	173,590	18,129,000	6,579,000	36.3	18,940	4,907,000	1,638,000	33.4	192,530	23,036,000	8,217,000	35.7
Wyoming	20,610	3,446,000	1,420,000	41.2	2,310	1,260,000	345,000	27.4	22,920	4,706,000	1,765,000	37.5
Total: 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
1936	8,017,390	343,346,000	251,617,000	73.3	656,720	111,623,000	53,693,000	48.1	8,674,110	454,969,000	305,310,000	67.1

[1] Includes natural gas used with manufactured gas. [2] Maryland includes District of Columbia and Virginia. [3] Utah includes North Dakota and Washington.

Field.—Field operations are estimated to have consumed 620 billion cubic feet of natural gas in 1938, 5 percent less than the 1937 total of 651 billion. Field use decreased in most States, but the most pronounced drop probably was in Oklahoma and Kansas. Active oil development in Illinois and Arkansas doubtless caused marked increases in field consumption in those States. In 1937 the three most important oil-producing States, Texas, California, and Oklahoma, with 76 percent of the United States output, used 541 billion cubic feet of gas for field purposes.

Carbon black.—The volume of natural gas burned in carbon-black manufacture in 1938 was 325 billion cubic feet, almost 5 percent less than in the record year 1937. Consumption in Texas declined only 0.5 percent and that in Louisiana 39 percent. The use of gas in carbon-black plants in the Monroe field of Louisiana has been decreasing for several years. The gas used in Oklahoma, Kansas, and Wyoming, the only other States producing carbon black, totaled slightly more in 1938 than in 1937 but represented only 3 percent of the national total.

Petroleum refineries.—The volume of natural gas consumed at petroleum refineries in 1938 is estimated to have increased about 8 percent over 1937 to 122 billion cubic feet. Although crude runs to stills at refineries in the United States as a whole were slightly less in 1938 than in 1937, they increased considerably in some of the districts where natural gas is used most widely as a refinery fuel. The refineries of Texas and California are by far the most important users of natural gas for this purpose. The use of natural gas at refineries has grown rapidly since 1933 when only 66 billion cubic feet were consumed.

Electric public-utility power plants.—A total of about 171 billion cubic feet of natural gas was used in 1938 to generate electric power at public-utility power plants, about the same quantity as in 1937. Therefore, the relative importance of natural gas as a source of energy in electric-power production increased somewhat in 1938, as the total consumption of all fuels was 9 percent less than in 1937. On the basis of the B. t. u. content of fuels consumed, natural gas supplied 13.8 percent of the total heat energy utilized in 1938 and 12.6 percent in 1937. Factors used in calculating the B. t. u. values of fuels were 26 million B. t. u. per short ton of coal, 6 million B. t. u. per barrel of fuel oil, and 1,050 B. t. u. per cubic foot of natural gas.

Portland-cement plants.—Natural gas consumed at portland-cement plants in 1938 totaled about 37 billion cubic feet, a decline of 8 percent from 1937. The reduction in demand was due to curtailment of cement production, which fell about 10 percent in 1938 in common with most industrial activities. Cement plants in the Mid-Continent area and Texas are the principal users of natural gas, probably owing to the low price for industrial gas in those sections.

Other industrial.—Depressed business conditions, which were felt particularly during the first three quarters of 1938, reduced substantially the demand for natural gas for miscellaneous industrial uses. It is estimated that "other industrial" demand in 1938 declined about 15 percent from 1937 to 510 billion cubic feet. Curtailment was particularly severe in Ohio, Pennsylvania, and West Virginia, where the steel and ceramic industries are large consumers.

Industrial consumption of natural gas in the United States in 1937, 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 plant	Other industrial	Total	Total	Average (cents)		Total	Average (cents)
Alabama								14,716,000	14,716,000	$2,495,000	17.0	14,716,000	$2,495,000	17.0
Arizona							1,824,000	9,745,000	11,569,000	2,329,000	20.1	11,569,000	2,329,000	20.1
Arkansas	6,577,000	$501,000				3,391,000	2,695,000	13,550,000	19,642,000	2,459,000	12.5	26,219,000	2,960,000	11.3
California	140,743,000	9,229,000				32,619,000	15,554,000	59,144,000	107,317,000	17,372,000	16.2	248,060,000	26,601,000	10.7
Colorado	372,000	17,000				2,000	425,000	13,532,000	13,959,000	2,190,000	15.7	14,331,000	2,207,000	15.4
District of Columbia								(1)	(1)	(1)	(1)	(1)	(1)	(1)
Florida								1,242,000	1,242,000	183,000	14.7	1,242,000	183,000	14.7
Georgia							3,596,000	4,710,000	8,306,000	1,408,000	17.0	8,306,000	1,408,000	17.0
Illinois	1,275,000	101,000				101,000	3,733,000	50,678,000	54,512,000	10,987,000	20.2	55,787,000	11,088,000	19.9
Indiana	152,000	17,000				354,000	7,864,000	13,021,000	21,239,000	4,606,000	21.7	21,391,000	4,623,000	21.6
Iowa							4,733,000	11,503,000	16,236,000	2,634,000	16.2	16,236,000	2,634,000	16.2
Kansas	21,762,000	1,634,000	(2)	(2)	(2)	5,588,000	16,357,000	[2] 28,587,000	[2] 50,532,000	[2] 6,541,000	[2] 12.9	72,294,000	8,175,000	11.3
Kentucky	1,220,000	158,000						6,568,000	6,568,000	1,772,000	27.0	7,788,000	1,930,000	24.8
Louisiana	32,022,000	1,987,000	39,406,000	$1,040,000	2.6	10,460,000	25,564,000	54,140,000	90,164,000	10,633,000	11.8	161,592,000	13,660.000	8.5
Maryland								[1] 557,000	[1] 557,000	[1] 343,000	[1] 61.6	[1] 557,000	[1] 343,000	[1] 61.6
Michigan	1,072,000	104,000				2,000		7,004,000	7,006,000	3,694,000	52.7	8,078,000	3,798,000	47.0
Minnesota							1,337,000	6,790,000	8,127,000	1,561,000	19.2	8,127,000	1,561,000	19.2
Mississippi							1,410,000	7,303,000	8,713,000	1,132,000	13.0	8,713,000	1,132,000	13.0
Missouri	409,000	70,000					8,306,000	23,170,000	31,476,000	5,453,000	17.3	31,885,000	5,523,000	17.3
Montana	1,501,000	98,000				580,000	691,000	9,384,000	10,655,000	1,500,000	14.1	12,156,000	1,598,000	13.1
Nebraska							2,819,000	8,252,000	11,071,000	1,947,000	17.6	11,071,000	1,947,000	17.6
New Mexico	16,414,000	378,000				104,000	3,436,000	5,759,000	9,299,000	1,348,000	14.5	25,713,000	1,726,000	6.7
New York	268,000	23,000				2,155,000	4,114,000	26,244,000	32,513,000	6,143,000	18.9	32,781,000	6,166,000	18.8
North Dakota							(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Ohio	2,569,000	443,000				20,000	3,738,000	50,556,000	54,314,000	18,016,000	33.2	56,883,000	18,459,000	32.5
Oklahoma	188,598,000	5,492,000	(2)	(2)	(2)	10,288,000	9,853,000	[2] 32,064,000	[2] 52,205,000	[2] 4,643,000	[2] 8.9	240,803,000	10,135,000	4.2
Pennsylvania	6,026,000	1,360,000				1,960,000	3,113,000	64,595,000	69,668,000	19,752,000	28.4	75,694,000	21,112,000	27.9
South Dakota							968,000	2,245,000	3,213,000	550,000	17.1	3,213,000	550,000	17.1
Tennessee						2,000	4,880,000	4,312,000	9,194,000	1,608,000	17.5	9,194,000	1,608,000	17.5
Texas	211,612,000	7,261,000	291,199,000	3,032,000	1.0	40,247,000	42,845,000	73,910,000	157,002,000	19,351,000	12.3	659,813,000	29,644,000	4.5
Utah	51,000	2,000				4,000	[3] 221,000	[3] 10,018,000	[3] 10,243,000	[3] 1,083,000	[3] 10.6	[3] 10,294,000	[3] 1,085,000	[3] 10.5

Virginia	----------	----------	----------	----------	--------	----------	----------	(1)	(1)	(1)	(1)	(1)	(1)	(1)
West Virginia	12, 162, 000	2, 083, 000	----------	----------	--------	686, 000	62, 000	29, 449, 000	30, 197, 000	6, 989, 000	23. 1	42, 359, 000	9, 072, 000	21. 4
Wyoming	6, 515, 000	241, 000	(2)	(2)	(2)	4, 442, 000	429, 000	[2] 5, 556, 000	[2] 10, 427, 000	[2] 798, 000	[2] 7. 7	16, 942, 000	1, 039, 000	6. 1
Miscellaneous	----------	----------	10, 480, 000	222, 000	2. 1	----------	----------	----------	----------	----------	--------	----------	----------	--------
Total: 1937	651, 320, 000	31, 199, 000	341, 085, 000	4, 294, 000	1. 3	113, 005, 000	170, 567, 000	637, 830, 000	921, 402, 000	161, 298, 000	17. 5	1, 913, 807, 000	196, 791, 000	10. 3
1936	618, 468, 000	28, 397, 000	283, 421, 000	3, 681, 000	1. 3	93, 183, 000	156, 080, 000	554, 397, 000	803, 660, 000	138, 051, 000	17. 2	1, 705, 549, 000	170, 129, 000	10. 0

[1] Maryland includes District of Columbia and Virginia.

[2] 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.

[3] Utah includes North Dakota.

Improved equipment and technique in utilization of natural gas in industry have brought about greater efficiency in the transfer of heat. A "hot tube" type of combustion apparatus has been developed which eliminates contact between the flue gases and the material being heated. A new industrial outlet for gas may develop from the invention of a new fabric similar to silk and said to be superior in some respects. Natural gas is a principal ingredient.

Mixed gas.—The volume of natural gas sold to consumers in 1937 for blending with manufactured gas declined 12 percent to 56 billion cubic feet from a 1936 total of 64 billion. The principal cause of the drop was a change in the Detroit area from the use of mixed to natural gas, which resulted in the transfer of about 400,000 meters to the straight natural-gas classification. The number of consumers in Iowa and Ohio also was reduced slightly in 1937.

Illinois consumes almost 40 percent of the natural gas sold with manufactured gas, as the Chicago metropolitan area is served with mixed gas. New York State is the second largest consumer of mixed gas, which is sold extensively in Buffalo and vicinity.

Consumption of natural gas used with manufactured gas in the United States in 1937, 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
California	5,120	233,000	400	57,000	48,000	338,000	$243,000
District of Columbia	142,800	2,757,000	6,480	274,000	427,000	3,458,000	2,527,000
Illinois	1,037,410	14,535,000	48,960	3,665,000	4,387,000	22,587,000	23,393,000
Indiana	29,730	377,000	1,230	76,000	34,000	487,000	540,000
Iowa	50,770	1,226,000	3,290	205,000	76,000	1,507,000	1,598,000
Kentucky	70,470	2,625,000	7,080	720,000	883,000	4,228,000	2,157,000
Maryland	15,280	295,000	300	7,000	11,000	313,000	281,000
Michigan	45,700	1,347,000	1,290	97,000	704,000	2,148,000	1,867,000
Minnesota	117,270	2,571,000	5,770	425,000	237,000	3,233,000	3,788,000
Missouri	220,490	2,696,000	10,780	337,000	247,000	3,280,000	3,256,000
Nebraska	54,180	994,000	480	73,000	141,000	1,208,000	755,000
New York	271,380	7,833,000	23,100	1,568,000	1,157,000	10,558,000	8,419,000
Ohio	150,550	386,000	14,790	125,000	104,000	615,000	368,000
Pennsylvania	53,080	1,237,000	2,370	236,000	118,000	1,591,000	1,166,000
Virginia	18,810	405,000	1,250	120,000	25,000	550,000	539,000
Total: 1937	2,283,040	39,517,000	127,570	7,985,000	8,599,000	56,101,000	50,897,000
1936	2,600,160	43,214,000	152,530	8,792,000	11,532,000	63,538,000	57,367,000

INTERSTATE SHIPMENTS

Interstate pipe lines carried 687 billion cubic feet of gas across State lines in 1937, an increase of approximately 20 percent over 1936. The volume of the interstate movement equaled 29 percent of total marketed production in 1937, 26 percent in 1936, and 24 percent in 1935.

Texas, Louisiana, and West Virginia, furnished 67 percent of all interstate shipments in 1937 and 69 percent in 1936. Several States of secondary importance as producers of gas increased their share of the total market. Among these, Kentucky and Pennsylvania each transported about 35 percent more gas to other States in 1937 than in 1936, Oklahoma 31 percent, New Mexico 29 percent, and New York 247 percent. Shipments to other States increased in all States except those from Colorado, Illinois, Indiana, and Ohio. The movement of a small amount of gas from Utah to Wyoming began in 1937. Substantial increases were reported in transportation of gas from New Mexico to Arizona, New York to Pennsylvania, and Pennsylvania to West Virginia.

Receipts of gas from other States gained moderately in Ohio and Illinois, the most important consumers. Ohio absorbed 82.7 billion cubic feet, of which 73.4 billion came from West Virginia and 8.7 billion from Kentucky. Illinois absorbed 77.6 billion, of which 57 billion came from Texas, 17.4 billion from Louisiana, and 3 billion from Kansas. Shipments into Michigan, which originated chiefly in Texas and Kansas, grew spectacularly from 4 billion in 1936 to 15 billion cubic feet in 1937 owing to the opening of the Detroit market to natural gas late in 1936.

Most Texas gas exports are from the Panhandle area. It will be noted from the following table that large volumes of gas are piped from Louisiana into Texas to serve markets in the eastern part of the State. The position of Kansas is unique among States whose developed gas reserves greatly exceed current needs. Gas piped into Kansas from Texas and Oklahoma has been substantially larger than outgoing volume in every recent year. In 1937 such imports were 56.3 billion cubic feet and exports 43.3 billion.

Interstate transportation of natural gas in 1937 [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	2,728,000
		Wyoming	153,000
			2,881,000
Indiana		Illinois	13,000
		Kentucky	89,000
		Ohio	1,000
			103,000
Kansas		Colorado	421,000
	Missouri	Illinois	2,973,000
	do Illinois	Indiana	2,892,000
	Nebraska	Iowa	7,026,000
	Missouri Illinois Indiana	Michigan	6,028,000
	Nebraska Iowa	Minnesota	6,214,000
		Missouri	7,783,000
		Nebraska	8,460,000
	Nebraska Iowa	do	4,000
		Oklahoma	573,000
	Nebraska Iowa	South Dakota	950,000
			43,324,000
Kentucky	West Virginia Virginia Maryland	District of Columbia	3,458,000
	Indiana	Illinois	185,000
		Indiana	1,211,000
	West Virginia Virginia Maryland District of Columbia	Maryland	313,000
	West Virginia Maryland	do	65,000
		Ohio	1,333,000

[1] Includes exports to Canada and Mexico.

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Interstate transportation of natural gas in 1937—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Kentucky—Continued	West Virginia	Ohio	7,346,000
	do	Pennsylvania	17,901,000
	do Virginia Maryland	do	26,000
	West Virginia	Virginia	401,000
	do Virginia Maryland District of Columbia	do	149,000
		West Virginia	12,653,000
			45,041,000
Louisiana	Mississippi	Alabama	15,948,000
	do Alabama Georgia	do	10,000
		Arkansas	24,705,000
	Mississippi Alabama	Georgia	13,865,000
	Arkansas Missouri	Illinois	17,367,000
		Mississippi	3,369,000
	Arkansas	do	2,152,000
	do	Missouri	14,843,000
	do Mississippi	Tennessee	13,336,000
		Texas	47,248,000
			152,843,000
Mississippi		Alabama	635,000
	Alabama	Florida	1,389,000
	do	Georgia	28,000
		Louisiana	3,490,000
			5,542,000
Missouri		Illinois	34,000
	Illinois	Indiana	34,000
	do Indiana	Michigan	75,000
			143,000
Montana		North Dakota	1,641,000
		South Dakota	3,505,000
			5,146,000
New Mexico	Texas New Mexico	Arizona	12,857,000
		Colorado	161,000
	Texas New Mexico Arizona	Mexico	867,000
		Texas	6,008,000
			19,893,000
New York		Canada	29,000
		Pennsylvania	9,925,000
			9,954,000
Ohio		Indiana	173,000
		Kentucky	2,000
		West Virginia	170,000
			345,000
Oklahoma		Arkansas	679,000
	Kansas Missouri	Illinois	81,000
	Kansas Missouri Illinois	Indiana	79,000
		Kansas	27,108,000
	Kansas Missouri Illinois Indiana	Michigan	165,000

Interstate transportation of natural gas in 1937—Continued

State from which gas was transported	State through which gas was transported	State to which gas was transported	M cubic feet
Oklahoma—Continued	Kansas	Missouri	10,321,000
	do	Nebraska	631,000
		Texas	1,618,000
			40,682,000
Pennsylvania	New York	Canada	49,000
		New York	38,709,000
	West Virginia	Ohio	530,000
		do	49,000
		West Virginia	6,067,000
			45,404,000
Texas	New Mexico	Colorado	19,928,000
	Oklahoma Kansas Missouri	Illinois	4,329,000
	Oklahoma Kansas Nebraska Iowa	do	52,628,000
	Oklahoma Kansas Missouri Illinois	Indiana	4,211,000
	Oklahoma Kansas Nebraska Iowa Illinois	do	13,503,000
	Oklahoma Kansas Nebraska	Iowa	14,328,000
	Oklahoma	Kansas	29,148,000
		Louisiana	8,205,000
		Mexico	3,923,000
	Oklahoma Kansas Missouri Illinois Indiana	Michigan	8,764,000
	Oklahoma Kansas Nebraska Iowa	Minnesota	6,897,000
	Oklahoma Kansas	Missouri	13,650,000
	Oklahoma Kansas	Nebraska	7,155,000
	Oklahoma Kansas Nebraska Iowa	do	4,000
		New Mexico	1,612,000
		Oklahoma	13,453,000
	Oklahoma Kansas Nebraska Iowa	South Dakota	1,054,000
	New Mexico Colorado	Wyoming	523,000
			203,315,000
Utah		do	91,000
West Virginia		Kentucky	7,385,000
		Maryland	633,000
		Ohio	71,856,000
	Kentucky	do	1,580,000
		Pennsylvania	21,060,000
	Virginia Maryland	do	65,000
			102,579,000
Wyoming		Colorado	1,000
		Montana	1,686,000
		Nebraska	1,009,000
		Utah	7,446,000
			10,142,000
			687,428,000

PIPE-LINE DEVELOPMENTS

Total mileage of natural-gas pipe lines built in 1938 was only about one-third of that in 1937. No major lines were constructed. Most new lines were laid to connect developed gas reserves to existing transportation systems. A few minor extensions were made to serve new markets.

The largest project reported comprised 53 miles of 18-inch pipe running from Bigelow Hills, Wyo., to Coalville, Utah. It serves principally as an added loop to the main line which supplies the Salt Lake City (Utah) market. Seven short lines were built in Texas, which ranged in length from 11 to 48 miles and most of which provided new outlets for gas fields.

A 14-mile 8-inch line was laid from Merced to Livingston, Calif., and 10 miles of 10-inch pipe were laid in the Montebello oil field. In Oklahoma, 14 miles of 10- and 12-inch line were installed between Cement and Chickasha. The Schuler oil field in Arkansas supplied gas to a 6-inch line to Eldorado, a distance of 18 miles. An extension of 39 miles of 16-inch pipe was made to a major pipe-line system from Ventura, Iowa, to Albert Lea, Minn.

In Pennsylvania 27 miles of 8-inch pipe were installed from the new Summit Hotel gas field to Waynesburg. Twenty-four miles of 16-inch line were laid from Howard to Perrysville, Ohio.

At least 60 percent of the gas lines of 6-inch and larger sizes that were built in 1938 were coupled by means of electric welds. A new technique for making pipe bends in the field attained rather wide favor in 1938. It is called wrinkle bending and involves heating strips of the pipe wall at right angles to the axis of the pipe to facilitate bending. It effects economies over older methods, as less equipment and smaller crews are required and somewhat less time is consumed per bend. A procedure has been developed for relieving the stresses that are normally produced in arc welds because of rapid temperature changes over a wide range. Stronger, more uniform welds result.

It has been found advantageous under certain conditions to build bridges to carry pipe lines across rivers rather than to embed the line below the river. This practice has become particularly important in parts of the Southwest where river channels are variable owing to shifting sands and where the river waters corrode steel pipe.

NATURAL GASOLINE

AND LIQUEFIED PETROLEUM GASES [1]

By G. R. Hopkins

SUMMARY OUTLINE

NATURAL GASOLINE

In 1938 the natural-gasoline industry, like most branches of the oil-and-gas industry, experienced a satisfactory year from the standpoint of production, stocks, and distribution, but profits were generally disappointing. This was largely because the low prices carried over from 1937 failed to rally until late in the year.

Salient statistics of the natural-gasoline industry in the United States, 1934–38, in thousands of gallons

	1934	1935	1936	1937	1938 [1]	Percent of change in 1938 from 1937
Production:						
Appalachian	58,601	61,315	65,669	72,056	67,625	−6.1
Illinois, Kentucky, and Michigan	8,570	10,106	10,361	12,319	12,812	+4.0
Oklahoma City	102,591	120,127	128,783	166,188	138,372	−16.7
Seminole	95,186	97,599	115,557	121,839	118,606	−2.7
Texas Panhandle	256,130	276,602	218,703	230,405	230,919	+.2
East Texas	46,280	78,210	140,091	185,313	185,475	+.1
Rocky Mountain	58,427	53,965	65,337	74,868	79,529	+6.2
Kettleman Hills	152,434	153,936	171,052	182,894	186,749	+2.1
Long Beach	76,147	83,653	89,366	84,297	93,209	+10.6
All other districts	680,994	716,473	791,421	935,255	1,000,018	+6.9
Total production	1,535,360	1,651,986	1,796,340	2,065,434	2,113,314	+2.3
Stocks:						
Total at plants, terminals, and refineries, Jan. 1	154,560	177,086	155,316	170,310	199,836	
Total at plants, terminals, and refineries, Dec. 31	157,060 [2] 177,086	155,316	170,310	199,836	202,860	+1.5
Net change	+2,500	−21,770	+14,994	+29,526	+3,024	
Total supply [3]	1,532,860	1,673,756	1,781,346	2,035,908	2,110,290	+3.7
Distribution:						
Blended at refineries [4]	1,132,152	1,271,760	1,367,814	1,596,294	1,621,704	+1.6
Run through crude-oil pipe lines in California	50,652	31,290	52,500	57,708	56,658	−1.8
Exports	214,242	135,366	107,058	148,428	202,230	+36.2
Direct shipments to consumers		116,340	139,230	143,640	137,970	−3.9
Losses	135,814	119,000	114,744	89,838	91,728	+2.1
Total distribution	1,532,860	1,673,756	1,781,346	2,035,908	2,110,290	+3.7

[1] Subject to revision.
[2] For comparison with 1935.
[3] Production plus or minus changes in stocks.
[4] Including amounts run through crude-oil pipe lines east of California.

[1] Data for 1938 are preliminary; detailed statistics with final revisions will be released later.

Production in 1938 was probably about 2,125,000,000 gallons (the preliminary total was 2,113,314,000 gallons), or about 60 million gallons above the final figure for 1937. However, the 1938 production was about 5 percent short of the record totals of 1929 and 1930. Texas failed to displace California as the leading producing State in 1938, as had been predicted, but as the gap between their outputs was closed in the middle of the year it is probable that Texas will be the leader in 1939.

The natural-gasoline industry maintained its position as a source of volatility in refinery gasoline, but at the expense of further reduction of the average vapor pressure and at generally lower prices. Exports of natural gasoline rose in spectacular fashion during 1938, but "direct" sales were lower than in 1937.

The average yield of natural gasoline declined slightly in 1937 but is believed to have increased in 1938 to about 1 gallon per thousand cubic feet of gas treated. The outstanding technical development of the year probably was the construction of a number of recycle plants—

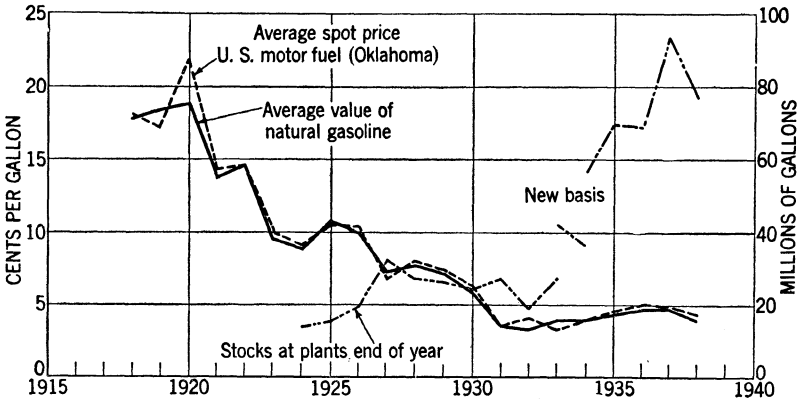

FIGURE 1.—Trends in average value of natural gasoline, spot price of gasoline, and stocks of natural gasoline, 1918–38.

installations that recover gasoline from so-called distillate wells and return the residue gas to the producing formations. Adjunctive to this development were improvements in the absorption process involving higher pressures and advanced refrigeration.

PRICES AND MARKET CONDITIONS

The price levels for natural gasoline were generally disappointing in 1938, although the fact that closing quotations on December 31 were higher than those at the first of the year was encouraging. The opening price of a representative grade of natural gasoline (26–70 in Oklahoma) was 3.00 cents per gallon on January 1, reached the year's low of 2.00 cents in February, and started a definite recovery in July which was maintained for the remainder of the year.

As shown in figure 1, the average value of natural gasoline has been below that of the cheapest grade of U. S. Motor gasoline in Oklahoma since about 1934. In 1938 the price differential widened to about 0.5 cent per gallon from about 0.2 cent in 1937, indicating a set-back for natural gasoline in competition with certain light refinery products.

Spot price of Mid-Continent natural gasoline, grade 26–70, on specified dates in 1938, with monthly and yearly averages, in cents per gallon

[National Petroleum News]

Date	Cents	Date	Cents	Date	Cents
Jan. 1	3.00	May 2	2.50	Sept. 6	3.25
3	3.00	9	2.13	12	3.25
10	3.00	16	2.00	19	3.25
17	3.00	23	2.00–2.13	26	3.00
24	2.50–2.63	31	2.13	Average	3.19
31	2.38	Average	2.16	Oct. 3	2.75
Average	2.79	June 6	2.13	10	2.75–3.00
Feb. 7	2.25–2.38	13	2.13	17	2.75–3.00
14	2.00	20	2.13	24	2.75–3.00
21	2.00	27	2.25	31	2.75–3.00
28	2.13–2.25	Average	2.16	Average	2.85
Average	2.13	July 5	2.38	Nov. 7	2.75–3.00
Mar. 7	2.38–2.50	11	2.63	14	3.00
14	2.50	18	2.63	21	3.13–3.25
21	2.50	25	3.00	28	3.25–3.38
28	2.50–2.63	Average	2.66	Average	3.09
Average	2.50	Aug. 1	3.00	Dec. 5	3.25–3.50
Apr. 4	2.50	8	3.25	12	3.63–3.75
11	2.50–2.63	15	3.25	19	3.75
18	2.50	22	3.25	27	3.75
25	2.50	29	3.25	Average	3.64
Average	2.52	Average	3.20	Average: 1938	2.74
				1937	3.69

EMPLOYMENT AND PRODUCTIVITY

The number of natural-gasoline plants has declined in recent years, but up to January 1, 1938, the capacity and number of workers employed increased steadily. This capacity (measured biennially) gained about 15 percent in the 2-year period, 1936–37. The average number of workers rose from 9,198 in 1936 to 9,429 in 1937, a gain of 3 percent. A loss of 5 percent or more in employment in 1938 is anticipated.

Part-time employment at natural-gasoline plants is relatively unimportant; in fact, many companies apparently never have part-time workers. The total number of part-time workers declined from 1,008 in 1936 to 734 in 1937, probably owing to a reduction in men engaged in new construction and replacement.

The hours per week of full-time workers at natural-gasoline plants are virtually the same as those of oil-field workers. In 1936 the average was 40.1 hours per week and in 1937, 41.3. The part-time employees worked about half the time—that is, nearly 1,000 hours a year. The production of natural gasoline increased more rapidly in 1937 than the number of man-hours of work, hence average productivity increased. The average productivity per man-hour in 1937 was 106.6 gallons compared with 99.6 gallons in 1936.

Employment at natural-gasoline plants, natural gasoline produced, and average output per man-hour in the United States, 1936–37, by States [1]

State	Average number of workers		Natural-gasoline production (thousands of gallons)		Labor productivity (gallons per man-hour)	
	1936	1937	1936	1937	1936	1937
Arkansas	99	90	11,957	11,285	57.2	62.7
California	1,728	1,720	593,416	623,894	183.7	183.8
Colorado	11	10	451	404	18.8	18.4
Illinois	56	46	2,337	2,567	19.8	24.2
Kansas	209	242	37,775	57,026	102.6	113.6
Kentucky	56	58	6,009	7,344	57.2	65.0
Louisiana	[2] 401	320	72,687	106,415	116.3	185.7
Michigan	21	19	2,015	2,408	42.9	57.3
Montana	16	9	2,071	2,296	50.5	88.3
New Mexico	96	120	28,921	38,253	148.3	154.9
Ohio	113	92	6,991	7,704	29.7	36.2
Oklahoma	[2] 2,600	2,660	418,591	492,290	78.4	88.8
Texas	[2] 2,790	3,125	520,547	615,281	94.8	94.7
West Virginia	559	520	44,389	50,379	41.6	46.6
Wyoming	227	208	33,894	33,915	73.8	82.3
New York and Pennsylvania	216	190	14,289	13,973	29.2	33.3
Total, United States	[2] 9,198	9,429	1,796,340	2,065,434	99.6	106.6

[1] Figures for 1938 not yet available. [2] Revised figures.

PRODUCTION

Trends in total output.—Except in 1933, when the East Texas field upset a number of precedents, the trend of natural-gasoline production over the last decade has conformed closely to that of crude-oil production. (See fig. 2.) In 1938, however, the output of crude oil declined 5 percent, whereas that of natural gasoline gained 2 percent. Increased yields in 1938 were no doubt responsible for this anomaly, although curtailment in crude-oil production is not followed generally by as large a decline in the output of casinghead gas.

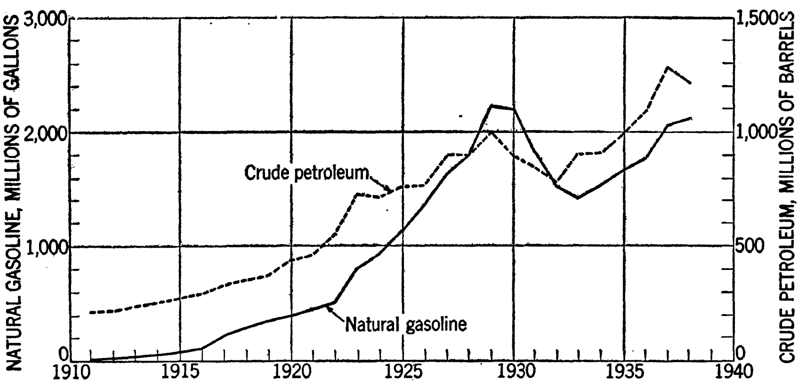

FIGURE 2.—Annual production of natural gasoline and crude petroleum, 1911–38.

The trend in daily average output of natural gasoline in 1938 was generally downward until August and September, after which an upward swing brought the average at the end of the year to just about what it was on January 1.

Monthly production of natural gasoline in the United States, 1937–38, by fields, in millions of gallons

Field	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1937													
Appalachian	6.9	7.0	7.8	6.4	5.5	4.5	4.3	4.3	5.0	6.5	6.6	7.2	72.0
Illinois, Kentucky, and Michigan	1.0	.9	1.1	1.0	1.0	.9	.9	.9	1.0	1.2	1.3	1.1	12.3
Oklahoma:													
Oklahoma City	13.1	11.7	12.0	12.7	13.2	12.4	14.9	15.3	16.6	15.5	14.4	14.4	166.2
Osage County	4.3	3.9	4.6	4.6	4.9	4.8	4.8	4.8	5.0	5.1	4.7	4.6	56.1
Seminole	8.2	8.2	9.9	10.0	10.7	10.4	10.7	10.8	10.8	11.3	10.3	10.5	121.8
Rest of State	10.7	10.3	11.9	12.1	12.3	12.1	12.5	12.7	13.0	13.7	13.1	13.8	148.2
Total, Oklahoma	36.3	34.1	38.4	39.4	41.1	39.7	42.9	43.6	45.4	45.6	42.5	43.3	492.3
Kansas	4.8	4.8	4.8	4.9	4.7	4.2	4.5	4.4	4.7	4.9	5.2	5.1	57.0
Texas:													
Gulf Coast	2.6	2.4	2.7	2.8	3.0	3.1	3.2	3.7	3.6	3.6	3.6	3.7	38.0
East Texas	10.9	12.6	13.4	15.2	15.9	16.9	18.2	18.6	17.7	17.2	14.1	14.6	185.3
North Texas	2.0	2.1	2.4	2.3	2.2	2.1	2.1	2.0	2.0	2.2	2.1	2.1	25.6
Panhandle	18.1	16.5	18.0	18.1	17.9	16.1	18.0	20.1	20.8	22.6	22.1	22.1	230.4
West-Central	5.5	5.4	6.0	5.7	5.8	5.5	5.8	5.8	6.1	6.4	6.2	6.0	70.2
Rest of State	4.2	4.4	4.9	5.0	5.5	5.4	6.1	6.4	6.2	6.1	5.7	5.9	65.8
Total, Texas	43.3	43.4	47.4	49.1	50.3	49.1	53.4	56.6	56.4	58.1	53.8	54.4	615.3
Louisiana	8.0	7.7	7.6	8.5	8.4	9.0	9.4	9.3	9.5	9.9	9.6	9.5	106.4
Arkansas	.9	.8	.9	1.0	1.0	1.0	1.0	1.0	.9	.9	.8	1.1	11.3
Rocky Mountain	5.6	5.3	5.8	5.8	6.0	5.8	6.6	6.7	7.1	7.1	6.5	6.6	74.9
California:													
Huntington Beach	3.3	3.1	3.5	3.5	3.6	3.5	3.6	3.5	3.4	3.5	3.4	3.4	41.3
Kettleman Hills	16.9	14.8	15.8	14.6	14.8	14.5	15.3	15.9	15.0	15.3	15.0	15.0	182.9
Long Beach	7.1	6.4	7.2	7.2	7.6	7.2	7.4	7.2	7.0	6.8	6.5	6.7	84.3
Santa Fe Springs	5.0	4.6	5.2	5.2	5.5	5.4	5.5	5.6	5.4	5.5	5.4	5.6	63.9
Ventura Avenue	5.2	4.9	5.4	4.8	4.8	4.6	4.7	4.8	4.6	5.0	5.4	5.7	59.9
Rest of State	14.7	13.9	15.5	15.0	15.4	15.3	16.1	16.4	16.2	17.5	17.3	18.3	191.6
Total, California	52.2	47.7	52.6	50.3	51.7	50.5	52.6	53.4	51.6	53.6	53.0	54.7	623.9
Total, United States	159.0	151.7	166.4	166.4	169.7	164.7	175.6	180.2	181.6	187.8	179.3	183.0	2,065.4
Daily average	5.1	5.4	5.4	5.5	5.5	5.5	5.7	5.8	6.1	6.1	6.0	5.9	5.7
1938 [1]													
Appalachian	7.3	6.3	6.8	5.8	5.0	4.1	3.8	4.1	4.6	5.6	6.6	7.6	67.6
Illinois, Kentucky, and Michigan	1.1	1.0	1.0	.9	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.4	12.8
Oklahoma:													
Oklahoma City	13.6	11.5	13.7	11.8	12.3	11.2	10.9	10.7	10.3	12.0	10.6	9.8	138.4
Osage County	4.3	3.7	4.2	3.9	4.1	4.0	4.2	4.3	4.5	5.0	4.2	4.5	50.9
Seminole	10.5	10.0	10.6	10.3	10.1	9.0	9.0	10.0	9.9	10.4	9.4	9.4	118.6
Rest of State	14.2	12.9	14.0	13.2	13.5	12.5	13.0	12.8	12.9	13.8	13.7	14.1	160.6
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	5.0	4.6	4.4	4.7	4.2	4.2	3.6	3.9	4.2	4.7	5.1	5.5	54.1
Texas:													
Gulf Coast	3.1	3.1	4.6	4.6	5.1	5.4	6.2	6.7	6.1	6.2	5.7	5.5	62.3
East Texas	14.8	13.3	16.2	15.7	15.2	15.5	18.3	17.4	14.6	15.8	14.3	14.4	185.5
North Texas	2.1	1.9	2.1	2.2	2.2	2.1	2.1	2.1	2.2	2.3	2.1	2.2	25.6
Panhandle	21.7	18.0	19.9	19.5	18.7	17.4	17.4	18.4	17.8	19.3	20.6	22.2	230.9
West-Central	6.0	5.3	6.1	5.6	5.6	5.5	5.9	5.9	5.5	6.1	6.0	6.1	69.6
Rest of State	5.8	5.7	6.6	6.7	6.7	6.6	7.6	7.8	7.2	7.5	6.8	7.0	82.0
Total, Texas	53.5	47.3	55.5	54.3	53.5	52.5	57.5	58.3	53.4	57.2	55.5	57.4	655.9
Louisiana	7.8	7.1	6.7	7.0	7.4	7.2	7.1	6.7	7.1	7.4	7.3	7.9	86.7
Arkansas	1.8	1.7	2.0	2.0	1.8	1.8	1.8	2.4	2.2	2.4	2.1	2.2	24.2
Rocky Mountain	6.2	5.7	6.1	5.9	6.7	6.4	6.9	6.9	6.8	7.6	7.1	7.2	79.5
California:													
Huntington Beach	3.6	3.3	3.7	3.5	3.7	3.5	3.7	3.6	3.4	3.6	3.4	3.5	42.5
Kettleman Hills	16.0	14.0	16.0	15.3	15.5	14.9	14.8	16.2	15.8	16.1	16.2	15.9	186.7
Long Beach	6.8	6.6	7.5	7.7	8.3	8.0	8.5	8.3	7.9	8.1	7.7	7.8	93.2
Santa Fe Springs	5.6	5.0	5.5	5.4	5.7	5.3	5.3	5.2	5.1	5.2	5.0	5.0	63.3
Ventura Avenue	5.3	4.7	4.5	4.5	4.8	4.6	4.5	4.5	4.5	5.0	5.1	5.3	57.3
Rest of State	19.5	17.9	19.5	19.0	18.6	17.8	17.7	18.6	17.8	18.5	18.1	18.0	221.0
Total, California	56.8	51.5	56.7	55.4	56.6	54.1	54.5	56.4	54.5	56.5	55.5	55.5	664.0
Total, United States	182.1	163.3	181.7	175.2	176.2	168.0	173.3	177.5	171.4	183.8	178.3	182.5	2,113.3
Daily average	5.9	5.8	5.9	5.8	5.7	5.6	5.6	5.7	5.7	5.9	5.9	5.9	5.8

[1] Subject to revision.

California.—Production in California continued the annual increase begun in 1934, the output in 1938 being 664,000,000 gallons (6 percent above 1937). The actual increase may have been as high as 8 percent, because the 1938 figures are subject to material revision. The chief factor affecting natural-gasoline production in California in 1938 was the degree of curtailment in crude-oil production. Strenuous efforts of the proration committees were rewarded with some decreases in crude-oil production in the middle and last quarter of the year, after which natural-gasoline production declined accordingly. The older fields of California just about held their own in production in 1938, Long Beach being a notable exception.

Louisiana.—Owing to the decline in output of the Rodessa oil field natural-gasoline production in Louisiana fell to 86,700,000 gallons in 1938 from 106,400,000 gallons in 1937. The crude-oil output of the State increased, but the gain was in the coastal fields where there are few natural-gasoline plants and where most of the gas is wasted.

Oklahoma.—Production decreased 5 percent in 1938, or from 492,300,000 gallons in 1937 to 468,500,000 in 1938. The "Rest of State", composed of many small fields outside the three major areas, increased its output but not enough to offset the material loss at Oklahoma City.

Texas.—Production in Texas continued to increase, the total of 655,800,000 gallons in 1938 being 7 percent above the previous peak in 1937. Although the Texas total for 1938 was slightly below that of California, indications are that Texas already has become the leading producing State, as it surpassed California in monthly output the middle of the year.

In 1938 production in the Panhandle and East Texas, the two leading districts, was virtually the same as in 1937. The output increased in "Rest of State" and in the Gulf Coast district, where considerable natural gasoline is produced incident to recycling operations.

Natural gasoline produced in the United States, 1934–38, by States, in thousands of gallons

Year	Arkansas	California	Colorado	Illinois	Kansas	Kentucky	Louisiana	Michigan	Montana	New Mexico
1934	13,033	506,272	643	3,810	27,891	4,171	40,558	589	1,237	21,748
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 [1]	24,235	663,992	320	2,455	54,133	6,997	86,693	3,360	1,767	47,453

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)
1934	85	5,881	355,438	10,781	466,570	41,854	34,799	1,535,360	60,523	3.9
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 [1]	28	7,379	468,460	10,685	655,835	49,533	29,989	2,113,314	78,195	3.7

[1] Subject to revision. [2] Includes Utah.

Other States.—Production in most of the other producing States decreased in 1938, Arkansas and New Mexico being the chief exceptions. In Arkansas the discovery of deep oil production has greatly increased the available supply of casinghead gas, and the output in 1938 was more than double that in 1937. Michigan increased production in 1938, but Illinois proved an exception to the general rule that natural-gasoline output follows the general trend of crude-oil yield. The output of crude oil in Illinois in 1938 was more than 200 percent higher than in 1937, yet the production of natural gasoline declined, because the gas-oil ratios of the new fields are relatively low; furthermore, most of the production is so scattered that the companies burn it in flares rather than go to the expense of piping it.

Natural gasoline produced and natural gas treated in the United States in 1937, by States [1]

State	Number of operators [2]	Number of plants operating	Natural gasoline produced			Natural gas treated	
			Thousands of gallons	Value at plants		Millions of cubic feet	Average yield per M cubic feet (gallons)
				Thousands of dollars	Average per gallon (cents)		
Arkansas	7	9	11,285	577	5.1	4,031	2.80
California	33	94	623,894	37,719	6.0	381,568	1.64
Colorado	2	2	404	16	4.0	153	2.64
Illinois	19	49	2,567	153	6.0	1,027	2.50
Kansas	13	21	57,026	2,192	3.8	153,416	.37
Kentucky	4	7	7,344	382	5.2	34,981	.21
Louisiana	19	30	106,415	4,300	4.0	144,474	.74
Michigan	2	2	2,408	103	4.3	1,381	1.74
Montana	1	1	2,296	161	7.0	9,062	.25
New Mexico	4	5	38,253	1,493	3.9	61,625	.62
New York	1	1	33	2	6.1	50	.66
Ohio	6	11	7,704	460	6.0	33,625	.23
Oklahoma	53	139	492,290	20,272	4.1	338,007	1.46
Pennsylvania	56	96	13,940	701	5.0	31,508	.44
Texas	63	135	615,281	24,329	4.0	754,696	.82
Utah			367	19	5.2		
West Virginia	24	86	50,379	2,528	5.0	140,512	.36
Wyoming	5	8	33,548	1,718	5.1	18,684	1.82
Total: 1937	[2] 249	696	2,065,434	97,125	4.7	2,108,800	.98
1936	[2] 263	700	1,796,340	84,572	4.7	1,815,000	.99

[1] Complete figures for 1938 not yet available.
[2] A producer operating in more than 1 State is counted only once.

CONSUMPTION AND MOVEMENTS

The indicated demand or distribution of natural gasoline in 1938 was about 2,110,000,000 gallons—4 percent higher than in 1937. The demand in 1938 was divided as follows: Utilized at refineries, 80 percent; exports, 10 percent; direct shipments to jobbers and retailers, 6 percent; and losses, 4 percent. Compared with similar data for 1937 these ratios indicate chiefly an increase in the importance of exports at the expense of refinery consumption.

Distribution of natural gasoline in the United States, 1937–38, by months, in thousands of gallons

	January	February	March	April	May	June	July	August	September	October	November	December	Total
1937													
Production	158, 970	151, 746	166, 362	166, 446	169, 722	164, 682	175, 602	180, 180	181, 608	187, 782	179, 298	183, 036	2, 065, 434
Decrease in stocks	966	----------	----------	----------	----------	----------	----------	----------	32, 046	35, 028	12, 474	16, 338	----------
	159, 936	151, 746	166, 362	166, 446	169, 722	164, 682	175, 602	180, 180	213, 654	222, 810	191, 772	199, 374	2, 065, 434
Used at refineries [1]	122, 640	102, 228	103, 866	108, 780	105, 966	102, 438	119, 196	144, 984	180, 138	179, 214	167, 706	159, 138	1, 596, 294
Run through pipe lines in California	3, 486	3, 444	4, 074	4, 410	4, 998	5, 544	6, 006	4, 410	8, 442	4, 620	3, 990	4, 284	57, 708
Exports [2]	10, 500	10, 542	9, 912	11, 214	10, 374	19, 236	5, 586	11, 004	14, 070	20, 748	11, 424	13, 818	148, 428
Direct shipments to consumers	11, 466	10, 794	12, 642	16, 086	11, 802	11, 256	10, 500	10, 878	13, 440	11, 760	11, 760	11, 256	143, 640
Increase in stocks	----------	10, 836	21, 378	20, 706	29, 274	11, 256	27, 762	5, 166	----------	----------	----------	----------	29, 526
Losses	11, 844	13, 902	14, 490	5, 250	7, 308	14, 952	6, 552	3, 738	−2, 436	6, 468	−3, 108	10, 878	89, 838
	159, 936	151, 746	166, 362	166, 446	169, 722	164, 682	175, 602	180, 180	213, 654	222, 810	191, 772	199, 374	2, 065,434
1938 [3]													
Production	182, 112	163, 338	181, 692	175, 182	176, 232	168, 042	173, 334	177, 492	171, 402	183, 750	178, 248	182, 490	2, 113, 314
Decrease in stocks	----------	----------	----------	----------	----------	----------	----------	----------	----------	58, 296	43, 218	38, 304	----------
	182, 112	163, 338	181, 692	175, 182	176, 232	168, 042	173, 334	177. 492	171, 402	242, 046	221, 466	220, 794	2, 113, 314
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]	7, 896	21, 420	9, 156	19, 866	21, 630	20, 790	10, 542	13, 524	8, 316	29, 190	18, 438	21, 462	202, 230
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	4, 620	12, 642	2, 142	−2, 058	10, 416	8, 148	1, 974	12, 768	5, 460	14, 112	13, 020	8, 484	91, 728
	182, 112	163, 338	181, 692	175, 182	176, 232	168, 042	173, 334	177, 492	171, 402	242, 046	221, 466	220, 794	2, 113, 314

[1] Includes quantities run through pipe lines east of California. [2] As reported to the Bureau of Mines by manufacturers. [3] Subject to revision.

Refinery utilization.—The proportion of natural gasoline in refinery gasoline continued to increase, rising to 7.2 percent in 1938 from 7.0 percent in 1937. This does not necessarily mean that the product was more indispensable in refinery operations but simply that the output of producers without refining facilities was absorbed at lower prices.

The two Gulf Coast districts, in which blending increased materially in 1937, used considerably less natural gasoline in 1938. On the other hand, California and Texas Inland, the two districts with the highest blending ratios, used even more natural gasoline in blending in 1938.

Percentage of natural gasoline blended in refinery gasoline, 1934–38, 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
1934	1.9	2.3	4.8	10.5	12.2	2.9	1.6	6.0	9.0	16.2	6.8
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]	1.6	1.4	4.7	8.8	15.5	4.3	2.2	6.8	5.8	17.6	7.2

[1] Subject to revision.

Natural gasoline blended at refineries in the United States, 1937–38, by districts and months, in thousands of gallons

District	January	February	March	April	May	June	July	August	September	October	November	December	Total
1937													
East Coast	5,376	3,654	3,360	3,234	2,352	2,058	2,142	5,460	7,644	12,852	8,484	8,064	64,680
Appalachian	1,512	1,344	1,428	1,134	1,134	840	966	966	1,134	1,428	1,764	1,554	15,204
Indiana, Illinois, Kentucky, etc.	12,810	11,634	13,020	15,414	14,322	13,062	12,684	11,970	15,414	17,430	17,766	15,708	171,234
Oklahoma, Kansas, and Missouri	22,680	19,068	16,716	15,708	15,876	15,918	16,758	21,042	26,334	27,552	24,612	22,176	244,440
Texas:													
Gulf Coast	13,608	12,138	11,508	15,792	19,740	15,204	19,740	31,038	44,016	32,256	33,936	33,684	282,660
Inland	17,598	16,212	19,572	15,666	16,002	16,464	20,076	23,100	23,520	25,914	23,898	26,250	244,272
Total, Texas	31,206	28,350	31,080	31,458	35,742	31,668	39,816	54,138	67,536	58,170	57,834	59,934	526,932
Louisiana-Arkansas:													
Louisiana Gulf Coast	1,092	966	1,344	1,302	1,638	2,562	4,116	4,158	5,880	5,292	4,200	2,520	35,070
Arkansas and Louisiana Inland	1,932	1,722	1,470	1,722	1,722	2,520	2,772	3,192	3,444	4,242	3,234	2,730	30,702
Total, Louisiana-Arkansas	3,024	2,688	2,814	3,024	3,360	5,082	6,888	7,350	9,324	9,534	7,434	5,250	65,772
Rocky Mountain	3,822	2,772	2,688	2,478	1,848	1,302	1,596	1,722	2,772	4,452	5,250	3,990	34,692
California [1]	42,546	36,162	36,834	40,740	36,330	38,052	44,352	46,746	58,422	52,416	48,552	46,746	527,898
Total, United States	122,976	105,672	107,940	113,190	110,964	107,982	125,202	149,394	188,580	183,834	171,696	163,422	1,650,852
1938 [2]													
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 [1]	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

[1] Includes natural gasoline run through pipe lines.

[2] Subject to revision.

"Direct" sales.—Although it might seem that the low refinery prices would have spurred producers to market low-vapor-pressure material direct to consumers, the quantity sold to jobbers and retailers declined from 143,640,000 gallons in 1937 to 137,970,000 in 1938. On the other hand, shipments to refinery-owned bulk plants increased from 27,869,000 gallons in 1937 to 39,270,000 in 1938.

The largest single interstate movement of natural gasoline to consumers other than refiners continued to be that from Oklahoma to Illinois; and the largest intrastate movement, that within Texas. Both movements increased in 1938 over 1937. "Direct" sales in Arkansas increased materially in 1938, whereas those in Kansas showed a severe decline.

Shipments of natural gasoline to jobbers, retailers, and refinery-owned bulk plants in the United States in 1938, by States, in thousands of gallons [1]

State from which natural gasoline was transported	State to which natural gasoline was transported							Total
	Texas	Illinois	Ohio	Oklahoma	Minnesota	Wisconsin	Other States	
Texas	37,633	2,455	169	547	8,346	4,776	7,058	60,984
Oklahoma	1,034	13,507	429	13,877	3,017	5,344	6,526	43,734
West Virginia			9,419				14,407	23,826
Arkansas		8			8		12,086	12,102
Louisiana	32	868		1,025	64	118	4,717	6,824
Ohio			4,842				1,112	5,954
Kansas		466	49	1,392	975	818	1,519	5,219
Other States	704	630	2,449		40	738	14,036	18,597
	39,403	17,934	17,357	16,841	12,450	11,794	61,461	177,240

[1] Subject to revision.

Water-borne shipments.—Data reported to the Bureau of Mines by manufacturers indicate total exports of 202,230,000 gallons (4,815,000 barrels) in 1938 compared with 148,428,000 gallons in 1937. The figures of the Bureau of Foreign and Domestic Commerce for exports are 3,738,000 barrels for 1937 and 6,114,000 for 1938. The sizable difference in the respective totals for 1938 probably represents natural gasoline mixed with crude oil for export, a practice that is reported to have grown rapidly in 1938. Exports of natural gasoline from California in 1938 remained about the same as in 1937, hence the large gain was recorded in exports from the Gulf. Shipments for blending at refineries in Netherland West Indies comprised the largest single item in 1938, with exports to United Kingdom, France, and Canada following in that order. Japan took 384,000 barrels in 1938 but Germany and Italy together only 64,000 barrels. About 70 percent of the total exports of natural gasoline in 1938 passed through the Galveston (including Houston) customs district.

STOCKS

Substantial withdrawals in the last 3 months of 1938 eased the stock situation, as the total rose only about 3,000,000 gallons—from 199,836,000 gallons on January 1 to 202,860,000 gallons on December 31. The gain was in refinery stocks, as stocks at plants and terminals declined about 16,000,000 gallons. More specifically, the responsibility for the increase rests with refinery stocks in California, which rose from about 82,000,000 gallons on January 1 to about 109,000,000 on December 31. Stocks at other points apparently reached unprecedented low levels, at least in terms of days' supply, which should be a helpful factor throughout 1939.

Stocks of natural gasoline in the United States, 1937–38, by months, in thousands of gallons

Date	At refineries				At plants and terminals				Total	
	California		Other States		Texas		Other States			
	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]	1937	1938 [1]
Jan. 1	75,768	81,774	25,914	24,654	45,423	57,988	23,205	35,420	170,310	199,836
Jan. 31	81,564	86,604	25,074	20,874	41,412	61,233	21,294	39,231	169,344	207,942
Feb. 28	87,864	98,196	23,394	25,746	44,284	47,159	24,638	39,613	180,180	210,714
Mar. 31	94,542	103,362	22,512	28,518	52,916	59,625	31,588	40,797	201,558	232,302
Apr. 30	97,734	108,780	20,538	26,964	66,845	74,600	37,147	49,174	222,264	259,518
May 31	105,630	118,398	18,900	24,570	79,151	77,410	47,857	54,638	251,538	275,016
June 30	110,082	129,360	22,512	24,696	75,905	77,595	54,295	60,291	262,794	291,942
July 31	111,342	134,358	29,862	25,284	85,409	96,756	63,943	63,390	290,556	319,788
Aug. 31	108,024	136,752	33,474	27,090	89,255	110,698	64,969	62,384	295,722	336,924
Sept. 30	90,384	138,726	45,150	26,544	77,856	122,584	50,286	54,824	263,676	342,678
Oct. 31	83,706	123,732	35,658	23,268	68,792	98,278	40,492	39,104	228,648	284,382
Nov. 30	82,362	120,624	29,778	18,732	69,632	71,896	34,402	29,912	216,174	241,164
Dec. 31	81,774	108,696	24,654	17,136	57,988	48,397	35,420	28,631	199,836	202,860

[1] Subject to revision.

TECHNICAL DEVELOPMENTS

Yields.—The upward trend in yields was arrested in 1937 when the national average was 0.98 gallon per thousand cubic feet compared with 0.99 gallon in 1936. However, indications are that the average yield will increase to at least 1.00 gallon in 1938, despite a decrease in average vapor pressure. The average yield in California and Texas, the two leading producers, gained in 1937 but not enough to overcome losses in Oklahoma and New Mexico.

Production by processes.—The number of straight compression plants continued to decline, but the production by this process (including vapor rectification) continued to rise. Production by the absorption (and combination) methods increased materially in 1937, and the process gave no evidence of decreasing in popularity. The number of charcoal plants was one less (10 to 9), and the total production by this method decreased after an unexpected gain in 1936.

Natural gasoline produced in the United States in 1937, 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		9			11,285	
California	3	91		8,622	615,272	
Colorado	1	1		143	261	
Illinois	49			2,567		
Kansas	6	15		2,271	54,755	
Kentucky	4	2	1	1,616	5,112	616
Louisiana	4	26		3,236	103,179	
Michigan	1	1		34	2,374	
Montana		1			2,296	
New Mexico		5			38,253	
New York	1			33		
Ohio	4	6	1	37	6,432	1,235
Oklahoma	35	104		40,832	451,458	
Pennsylvania	83	12	1	2,912	10,853	175
Texas	24	111		126,890	488,391	
Utah					[3] 367	
West Virginia	59	21	6	12,163	31,648	6,568
Wyoming	3	5		27,063	6,485	
Total: 1937	277	410	9	228,419	1,828,421	8,594
1936	286	404	10	213,188	1,573,904	9,248

[1] Figures for 1938 not yet available.
[2] Includes combination of absorption process with compression and charcoal processes.
[3] Drip gasoline.

Trends in vapor pressures.—The weighted average vapor pressure of all shipments of natural gasoline continued to decline, falling to 19.6 pounds in 1938 from 20.0 pounds in 1937. The decrease was chiefly in refinery shipments, as the average vapor pressure of exports rose 0.1 pound (17.1 to 17.2 pounds) while that of "direct" shipments fell only 0.1 pound (15.7 to 15.6 pounds). The downward trend in vapor pressures reflects the constant effort required to keep natural gasoline a primary source of volatility at refineries. Unfortunately, reducing the butane content to make a more stable product generally lowers the octane rating, hence the interest of the industry in such matters as compression ratios, volatility specifications, and carburetor design.

Technical improvements.—No figures on polymerization were collected in 1938, but it is safe to say that application of the process expanded materially. However, most of the expansion was at refineries, that at natural-gasoline plants remaining the exception. The desire to maintain the position of natural gasoline in the octane race was the prime motive in experiments by which isopentane, a high-octane product, was made from natural gasoline by polymerization. The idea apparently has possibilities, but its application is still in the experimental stage.

Probably the most important improvements in established methods were those permitting the use of much higher pressures in the absorbers. This development was of particular significance where the gas was returned to the sand. Higher yields at absorption plants are being obtained by advanced refrigeration, through which the lean oil is cooled by the expansion of butane-propane mixtures.

LIQUEFIED PETROLEUM GASES [2]

Despite uncertain economic conditions during 1938, sales of liquefied petroleum gases continued to gain although at a lower rate than in recent years. Domestic deliveries in 1938 were 165,201,000 gallons compared with 141,400,000 gallons (revised) in 1937.

Sales of liquefied petroleum gases, 1933–38, 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	[1] 45, 399	46, 694	2, 833	[1] 141, 400
1938 [2]	54, 130	52, 768	56, 050	2, 253	165, 201

[1] Revised figures. [2] Subject to revision.

All principal uses for liquefied petroleum gases were greater in 1938 than in 1937 except deliveries for industrial fuel, which declined in 1938 owing to generally curtailed manufacturing operations. Sales of liquefied petroleum gases for domestic consumption expanded noticeably in 1938, increasing 42 percent as the advantages of this type of fuel for cooking, heating, air conditioning, refrigeration, power, and lighting for the home, the farm, the camp, and the small establishment became known more widely. Requirements for chemical manufacturing and internal-combustion-engine fuel mounted more than 20 percent in 1938 compared with 1937, while sales of liquefied petroleum gases to gas-manufacturing companies in 1938 were 11 percent above the 1937 total. Exports of liquefied petroleum gases continued the decline of recent years and were reported as 825,000 gallons in 1938 compared with 1,984,000 gallons in 1937 and 5,125,000 gallons in 1936. The marketed production of liquefied petroleum gases, including both domestic and export deliveries, totaled 166,026,000 gallons in 1938, or 16 percent over the 1937 requirements of 143,384,000 gallons.

In 1938, as in 1937, total deliveries of liquefied petroleum gases were divided about equally among propane, butane, and propane-butane mixtures, while pentane sales remained relatively unimportant. Propane sales of 54,130,000 gallons in 1938 were 16 percent above the 1937 total of 46,474,000 gallons, while butane deliveries of 52,768,000 gallons in 1938 likewise were 16 percent more than in 1937. The market for propane-butane mixtures increased from 46,694,000 gallons in 1937 to 56,050,000 in 1938, or 20 percent. Sales of pentane, which declined for the first year since 1933, were reported as 2,253,000 gallons in 1938 compared with 2,833,000 in 1937.

A review of 1938 sales of liquefied petroleum gases reveals that the domestic or "bottled-gas" demand took the lead over industrial-fuel requirements. Domestic sales of 57,832,000 gallons in 1938 represent 35 percent of total deliveries compared to 29 percent in 1937. It should be noted, however, that this reversal in the market demand probably is temporary, as 1938 was a year of retarded ac-

[2] By A. T. Coumbe, Petroleum Economics Division, Bureau of Mines.

tivity in manufacturing. Consequently requirements for industrial fuel were somewhat below normal, as shown by deliveries of 38,849,000 gallons in 1938—10 percent less than the 1937 total of 43,310,000 gallons. The extent of the decline in the use of liquefied petroleum gases in 1938 for industrial fuel is illustrated further by the fact that this particular use constituted about 31 percent of the total demand in 1937 but less than 24 percent in 1938.

Sales of liquefied petroleum gases to gas-manufacturing companies for direct resale through their mains or for mixture with other gases increased 11 percent in 1938 to a total of 12,386,000 gallons. Deliveries for this use, however, declined from 7.9 percent of the marketed production in 1937 to 7.5 percent in 1938. Sales of liquefied petroleum gas credited to chemical manufacturing were 32,299,000 gallons in 1938, or 21 percent over 1937 sales of 26,792,000 gallons, but the 1938 increase was much less than that in 1937, when sales for this purpose virtually doubled the 1936 quantity (14,445,000 gallons). The steady growth in the sale of liquefied petroleum gases for use as fuel in internal-combustion engines continued in 1938, when 20,914,000 gallons were delivered—a gain of 23 percent over the 1937 demand of 16,987,000 gallons. Liquefied petroleum gases have proved quite satisfactory as fuel in heavy-duty automotive equipment and power engines, so further development along this line may be expected.

The market for propane increased from 46,474,000 gallons in 1937 to 54,130,000 gallons in 1938. In 1938, as in previous years, the bulk of the propane was delivered for domestic consumption, the quantity increasing from 30,436,000 gallons in 1937 to 37,556,000 in 1938. Propane sold for industrial fuel declined slightly from 14,490,000 gallons in 1937 to 14,316,000 in 1938, while that delivered for gas manufacturing increased noticeably from 1,077,000 gallons in 1937 to 1,491,000 in 1938.

Sales of butane increased 16 percent—from 45,399,000 gallons in 1937 to 52,768,000 in 1938. Butane is in greatest demand as an industrial fuel where temperature control in manufacturing processes is important; however, because of the slower industrial pace in 1938, this use declined from 28,071,000 gallons in 1937 to 23,405,000 in 1938. The domestic consumption of butane, which doubled in 1937 compared with 1936, continued the sharp upward trend in 1938, when sales increased to 13,194,000 gallons from 6,047,000 in 1937. It is also of interest that domestic use ranked second as an outlet for butane in 1938, supplanting gas manufacturing which dropped to third place. The rapid growth in the domestic demand for butane is confined largely to the South Central States, where petroleum refineries and gasoline plants furnish a ready supply. Butane predominates in deliveries of liquefied petroleum gases to gas-manufacturing companies, and 8,270,000 gallons of this gas were sold for gas manufacturing in 1938 compared with 7,325,000 gallons in 1937. Sales for this use in 1938 were exceeded only by deliveries of butane for industrial and domestic consumption. The use of butane as fuel in internal-combustion engines gained sharply in 1938, when 5,025,000 gallons were reported compared with 1,715,000 gallons in 1937. Furthermore the percentage of butane in internal-combustion-engine fuel increased from 10 percent in 1937 to 24 percent in 1938.

Propane-butane mixtures are important as solvents and raw material to chemical manufacturers who buy more than half of the marketed production. Data released now for the first time show that the demand for propane-butane mixtures for use in chemical manufacturing totaled 12,223,000 gallons in 1936 and doubled to 24,601,000 gallons in 1937. The increase was not as spectacular in 1938 owing to adverse economic conditions; however, 30,496,000 gallons of propane-butane mixtures were absorbed in the manufacture of chemicals during the year. Propane-butane mixtures make an ideal internal-combustion-engine fuel under some conditions of service and load, and developments in that direction have made rapid progress. Sales of propane-butane mixtures for motor fuel increased from 14,994,000 gallons in 1937 to 15,509,000 in 1938, the larger share of the demand in both years being reported for the Pacific Coast States. Propane-butane mixtures are relatively unimportant as a domestic fuel; however, sales for that use increased from 3,504,000 gallons in 1937 to 6,316,000 in 1938.

Pentane sales declined from 2,833,000 gallons in 1937 to 2,253,000 in 1938. The consumption of pentane by chemical plants dropped from 1,907,000 gallons in 1937 to 1,413,000 in 1938, and domestic sales fell from 836,000 gallons in 1937 to 766,000 in 1938.

The American Gas Association has cooperated in the current annual survey of the marketed production of liquefied petroleum gases by reporting the pertinent details of the distribution by gas companies as follows:

At the end of 1938, liquefied petroleum gas was being delivered through mains to consumers in 193 communities in 31 States by 80 companies supplying 38,400 customers.

Butane-air gas with heating value ranging from 520 to 900 B. t. u. per cubic foot was supplied to 140 communities in 30 States by 70 companies. A mixture of undiluted butane and propane gas with a heating value of 2,800 to 3,000 B. t. u. per cubic foot was supplied to 13 communities in California by 5 companies. Undiluted propane gas with a heating value of 2,550 B. t. u. per cubic foot was supplied to 40 communities in Maryland, Minnesota, New Jersey, North Dakota, Virginia, and Wisconsin by 6 companies.

A gain from 21 percent in 1937 to 22.5 in 1938 in cylinder or drum shipments of liquefied petroleum gases is associated with the large increase (42 percent) in domestic sales. This is substantiated by the reported data that show cylinder shipments for domestic use of 35,424,000 gallons out of total cylinder shipments for all uses of 37,140,000 gallons in 1938 compared with cylinder shipments for domestic use of 26,097,000 gallons out of total shipments of 29,926,000 gallons in 1937. Largely because of contracted industrial requirements, bulk handling of liquefied petroleum gases in tank cars and tank trucks declined from 78.8 percent of total deliveries in 1937 to 77.5 percent in 1938.

Forty distributors of liquefied petroleum gases reported their sales to the Bureau of Mines in the 1938 survey compared with 33 in 1937. In the Pacific Coast area 11 companies responded to the request compared with 10 in 1937.

Sales of liquefied petroleum gases in the United States, 1937–38, by uses, methods of transportation, and regional distribution, in thousands of gallons

	Propane	Butane	Propane-butane mixtures	Pentane	Total	Percent
1937						
By uses:						
Domestic	30,436	6,047	3,504	836	40,823	[1] 29.0
Gas manufacturing	1,077	[1] 7,325	2,765	8	[1] 11,175	[1] 7.9
Industrial fuel	14,490	28,071	699	50	43,310	30.6
Chemical manufacturing	77	207	24,601	1,907	26,792	18.9
Internal-combustion-engine fuel	278	1,715	14,994	----------	16,987	12.0
All other uses	116	2,034	131	32	2,313	1.6
	46,474	[1] 45,399	46,694	2,833	[1] 141,400	100.0
Percent of total	32.9	32.1	33.0	2.0	100.0	----------
By method of transportation:						
Bulk	22,650	[1] 43,593	42,589	2,642	[1] 111,474	[1] 78.8
Cylinders	23,824	1,806	4,105	191	29,926	[1] 21.2
	46,474	[1] 45,399	46,694	2,833	[1] 141,400	[1] 100.0
Regional distribution:						
Pacific Coast area	6,266	5,447	18,085	----------	29,798	21.1
All other areas	40,208	[1] 39,952	28,609	2,833	[1] 111,602	78.9
	46,474	[1] 45,399	46,694	2,833	[1] 141,400	100.0
1938 [2]						
By uses:						
Domestic	37,556	13,194	6,316	766	57,832	35.0
Gas manufacturing	1,491	8,270	2,617	8	12,386	7.5
Industrial fuel	14,316	23,405	1,112	16	38,849	23.5
Chemical manufacturing	347	43	30,496	1,413	32,299	19.5
Internal-combustion engine fuel	380	5,025	15,509	----------	20,914	12.7
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	----------
By method 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

[1] Revised figures. [2] Subject to revision.

CARBON BLACK

By G. R. Hopkins and H. Backus

SUMMARY OUTLINE

The year 1938 was not a particularly prosperous one for the carbon-black industry. Compared with 1937 domestic sales and exports dropped 20 and 9 percent, respectively. However, the most depressing feature was the decline in price; the average f. o. b. plant value fell from 3.41 cents per pound in 1937 to 2.41 cents in 1938. The severe break in prices occurred in the last half of 1937, when rubber consumption was falling rapidly. Recovery in the rubber industry was gradual in 1938, but competitive conditions, plus sharp declines in sales for ink, paint, and miscellaneous uses prevented any substantial late-season rise in carbon-black prices. The situation was complicated further by the insistence of tank-car shippers that the quotations reflect their lower handling costs.

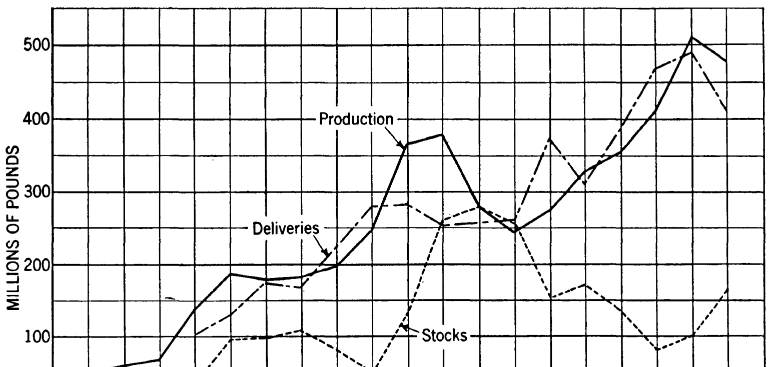

Figure 1.—Production, stocks, and deliveries of carbon black, 1919–38.

As shown in figure 1, production declined in 1938 for the first time since 1932. Stocks increased substantially in 1938 but at the end of the year were far below the depression peaks of 1930–32.

Salient statistics for carbon black made from natural gas in the United States, 1934–38

	1934	1935	1936	1937	1938
Number of producers reporting	25	21	20	24	24
Number of plants	50	54	54	57	55
Quantity produced:					
By States and districts:					
Louisiana pounds	66,538,000	64,875,000	59,201,000	66,381,000	39,534,000
Texas:					
Panhandle district do	237,403,000	263,361,000	321,576,000	405,247,000	382,369,000
Rest of State do	[1] 24,887,000	[1] 24,513,000	12,330,000	15,821,000	34,735,000
Total Texas do	[1] 262,290,000	[1] 287,874,000	333,906,000	421,068,000	417,104,000
Other States do	(1)	(1)	18,238,000	23,157,000	20,401,000
Total United States do	328,828,000	352,749,000	411,345,000	510,606,000	477,039,000
By processes:					
Channel process do	293,546,000	316,284,000	366,876,000	444,427,000	441,284,000
Other processes [2] do	35,282,000	36,465,000	44,469,000	66,179,000	35,755,000
Stocks held by producers Dec. 31 pounds	171,799,000	136,086,000	79,582,000	100,497,000	166,159,000
Losses do	386,000	926,000	113,000	76,000	[3] 65,000
Quantity sold:					
Domestic:					
To rubber companies do	165,446,000	213,708,000	278,018,000	[4] 269,584,000	217,231,000
To ink companies do	16,146,000	15,177,000	17,787,000	18,116,000	14,131,000
To paint companies do	5,365,000	6,550,000	6,914,000	6,159,000	4,229,000
For miscellaneous purposes pounds	5,035,000	9,916,000	10,299,000	11,503,000	7,883,000
Total domestic sold do	191,992,000	245,351,000	313,018,000	[4] 305,362,000	243,474,000
Export do	120,620,000	142,185,000	154,718,000	[4] 184,253,000	167,968,000
Total sold do	312,612,000	387,536,000	467,736,000	489,615,000	411,442,000
Value (at plants) of carbon black produced:					
Total	$11,654,000	$13,755,000	$16,110,000	$17,389,000	$11,486,000
Average per pound cents	3.54	3.90	3.92	3.41	2.41
Estimated quantity of natural gas used M cubic feet	229,933,000	241,589,000	283,421,000	341,085,000	324,950,000
Average yield per M cubic feet pounds	1.43	1.46	1.45	1.50	1.47

[1] Oklahoma and Wyoming included with "Texas: Rest of State."
[2] Lewis, roller, "special," and thermatomic.
[3] Gain.
[4] Revised figures.

PRODUCTION

By States, districts, and months.—The decline in output in 1938 was general throughout all producing States, Oklahoma being the chief exception. Louisiana's output showed a material decrease (40 percent) but that of Texas nearly held its own, dropping only from 421,068,000 pounds in 1937 to 417,104,000 pounds in 1938. Production in the Texas Panhandle declined in 1938 for the first time since 1932, but increased activities in West Texas raised the output in "Rest of State" from 15,821,000 pounds in 1937 to 34,735,000 pounds in 1938.

According to estimates based on monthly figures of the National Gas Products Association, the average daily output of carbon black declined until about midyear then partly recovered under the stimulus of buying at bargain prices.

Carbon black produced in the United States, 1934–38, by States

Year	Production (thousands of pounds)				Average value per pound (cents)
	Louisiana	Texas	Other States	Total	
1934	66,538	[1] 262,290	(1)	328,828	3.54
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	[2] 20,401	477,039	2.41

[1] Oklahoma and Wyoming included with Texas.
[2] Oklahoma and Wyoming.
[3] Kansas, Oklahoma, and Wyoming.

Carbon black produced from natural gas in the United States in 1938, by States and by major producing districts

State and district	Producers reporting [1]	Number of plants	Production			Estimated quantity of natural gas used (M cubic feet)	Average yield per M cubic feet (pounds)
			Pounds	Value at plant			
				Total	Average (cents)		
Kansas	1	1	(2)	(2)	(2)	(2)	(2)
Louisiana: Monroe-Richland district (Morehouse Ouachita and Richland Parishes)	8	11	39,534,000	$1,376,000	3.48	24,143,000	1.64
Oklahoma	2	2	[2] 20,401,000	[2] 520,000	[2] 2.55	[2] 11,151,000	[2] 1.83
Texas:							
Panhandle district (Carson, Gray, Hutchinson, Moore, and Wheeler Counties)	19	33	382,369,000	8,812,000	2.30	267,770,000	1.43
Rest of State (Eastland, Stephens, Ward, and Winkler Counties)	5	7	34,735,000	778,000	2.24	21,886,000	1.59
Total, Texas	[1] 19	40	417,104,000	9,590,000	2.30	289,656,000	1.44
Wyoming	1	1	(2)	(2)	(2)	(2)	(2)
Total United States	[1] 24	55	477,039,000	11,486,000	2.41	324,950,000	1.47

[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 and Wyoming included with Oklahoma.

Carbon black produced in the United States in 1938, by months, in pounds

Month	National Gas Products Association	Bureau of Mines [1]		Month	National Gas Products Association	Bureau of Mines [1]	
		Total	Daily average			Total	Daily average
January	43,091,992	46,272,783	1,492,670	August	36,084,709	38,640,159	1,246,457
February	37,437,830	40,071,276	1,431,117	September	35,355,656	38,163,120	1,272,104
March	38,449,578	41,025,354	1,323,399	October	37,162,293	40,071,276	1,292,622
April	35,406,415	38,163,120	1,272,104	November	35,985,172	38,640,159	1,288,005
May	36,564,944	39,117,198	1,261,845	December	37,861,199	40,548,315	1,308,010
June	34,608,896	37,209,042	1,240,301				
July	36,395,016	39,117,198	1,261,845		444,403,700	477,039,000	1,306,956

[1] Monthly figures obtained by allocating the Bureau's annual total proportionately to the Association's monthly data.

Methods and yields.—Output by processes other than the regulation channel process dropped from 66,179,000 pounds in 1937 to 35,755,000 pounds in 1938, whereas production by the channel process decreased only from 444,427,000 to 441,284,000 pounds. Apparently the producers of high-yield retort blacks, which comprise the major part of the production of "other types," preferred to lose some of their market rather than meet all cuts in the price of channel black.

The yield of carbon black, which reached a peak of 1.50 pounds per thousand cubic feet in 1937, fell to 1.47 pounds in 1938. Doubtless this decrease was related to the material decline in production by special processes, some of which have relatively high yields.

Research on carbon black by producers and consumers was perhaps intensified in 1938. Much of the research resulted in narrowing the specifications for use of carbon black in rubber. The relative proportion of "dustless" production continued to increase rapidly; and a collateral development, shipments in bulk, grew as fast as finances would permit.

Number and daily capacity of carbon-black plants operated in the United States, 1937–38, by counties or parishes

State	County or parish	Number of plants 1937	Number of plants 1938	Total daily capacity (pounds) 1937	Total daily capacity (pounds) 1938
Kansas	Grant	1	1	(1)	(1)
Louisiana	Morehouse	3	2	27,550	23,850
	Ouachita	9	9	225,775	225,775
	Richland	1		3,500	
		13	11	256,825	249,625
Oklahoma	Beckham	1	1	[1] 76,750	[1] 76,750
	Seminole	1	1		
		2	2	[1] 76,750	[1] 76,750
Texas	Carson	1	1	411,450	413,700
	Moore	6	6		
	Wheeler	2	2		
	Eastland	1	1	107,300	107,300
	Stephens	4	4		
	Ward	1	1		
	Winkler	1	1		
	Gray	10	10	338,120	340,360
	Hutchinson	[2] 14	[2] 14	[2] 545,620	[2] 548,120
		40	40	1,402,490	1,409,480
Wyoming	Niobrara	1	1	(1)	(1)
United States		57	55	1,736,065	1,735,855

[1] Kansas and Wyoming included with Oklahoma.
[2] 1 plant, located in both Carson and Hutchinson Counties, counted in Hutchinson County.

Number and capacity of plants.—The construction of new capacity for the manufacture of carbon black was at a standstill in 1938, which was natural in view of the overproduction and low prices. No new plants were built; on the other hand three were removed from the operating list as either dismantled or shut down.

The total capacity of the operating plants remained virtually constant in 1938 at about 1,736,000 pounds daily. A decline of about 7,000 pounds in capacity in Louisiana was compensated by a similar gain in Texas. The ratio of operating capacity to total plant capacity declined from 81 percent in 1937 to 75 percent in 1938.

Producers.—Carbon-black producers in 1938 were essentially the same as shown in Minerals Yearbook 1938 except that the Dewdrop plant of the United Carbon Co., the Pampa plant of the Magnolia Petroleum Co., and the Pioneer plant of the Peerless Carbon Black Co. were removed from the list as either inoperative or dismantled.

DEMAND

Total deliveries.—Sales of carbon black in 1938 totaled 411,442,000 pounds, 16 percent less than in 1937. Domestic sales in 1938 were 243,474,000 pounds and exports 167,968,000 pounds, indicating a gain in the relative importance of sales to foreign countries. (See fig. 2.)

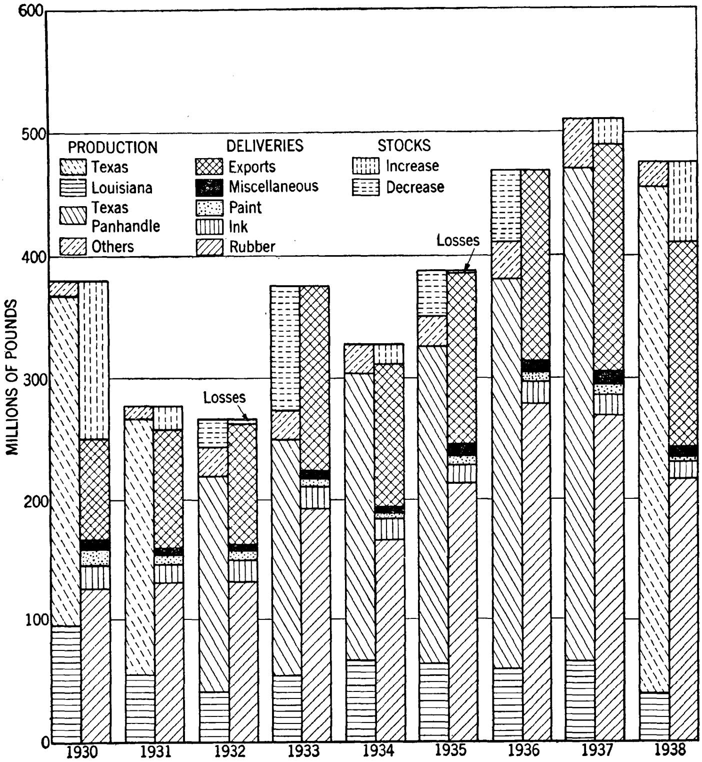

FIGURE 2.—Production and consumption of carbon black, 1930–38.

Domestic consumption.—Domestic sales in 1938 were 20 percent less than in 1937. Reports from producers indicate that domestic sales in 1938 were divided as follows: Rubber companies, 217,231,000 pounds (89 percent); ink companies, 14,131,000 pounds (6 percent); paint companies, 4,229,000 pounds (2 percent); and miscellaneous purposes, 7,883,000 pounds (3 percent). These data indicate chiefly a small increase in the relative importance of sales to rubber companies at the expense of sales for miscellaneous purposes.

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 declined 21 percent in 1938, or from 705,600 long tons in 1937 to 558,800 in 1938. Of the 1938 total, 437,000 long tons was crude rubber, 120,800 reclaimed rubber, and 1,000 synthetic rubber. Thus in 1938, as opposed to 1937, the consumption of reclaimed rubber, in which relatively little carbon black is used, decreased more than that of crude rubber. Furthermore, the consumption of latex, another type of rubber requiring little carbon black, declined relatively more in 1938 than that of crude rubber. According to statistics of the Rubber Manufacturers Association, the reduction in output of casings (from 53,300,000 in 1937 to 40,100,000 in 1938) was relatively greater than that in rubber consumption but may have been partly offset by a further increase in the average quantity of carbon black used per casing. Summarizing, the decline in sales of carbon black to rubber companies in 1938 (20 percent) was less than the decline in rubber consumption partly because relatively more crude rubber was used, possibly because the average size of casings increased, and probably because the rubber companies increased their stocks late in the year.

The apparent consumption of crude rubber in the world was 944,000 long tons, 14 percent less than the revised total of 1,103,600 long tons in 1937. These data indicate a further decline in the relative importance of the United States as a manufacturer of rubber in 1938 but a further strengthening of its paramount position as a supplier of carbon black.

The business recession of 1938 was attended by a marked decline in advertising and newsprint consumption, hence consumption of ink declined materially. 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 1938 was 3,089,100 short tons, or 27 percent below 4,260,700 short tons for 1937. Sales of carbon black to ink companies decreased from 18,116,000 pounds in 1937 to 14,131,000 pounds in 1938. Speculative buying of carbon black by ink manufacturers may have caused this decline (22 percent) to be less than the drop in apparent consumption of newsprint.

Sales of carbon black to paint companies dropped from 6,159,000 pounds in 1937 to 4,229,000 in 1938, or 31 percent. This decrease checks reasonably well information supplied by E. C. Wood, Chemicals Division, Bureau of Foreign and Domestic Commerce, to the effect that paint production in 1938 was probably 20 to 25 percent below that in 1937.

Sales of carbon black for miscellaneous purposes fell sharply in 1938—from 11,503,000 pounds in 1937 to 7,883,000 in 1938. No details are available as to the particular sales or uses that declined. Probably the situation is not as dark as the 1938 figures indicate, as favorable results from research have been rumored.

Losses incurred in handling carbon black, which have been declining in recent years, were transformed into a net gain of 65,000 pounds compared with a loss of 76,000 pounds in 1937.

Exports and imports.[1]—Exports of carbon black, after inceasing for 3 successive years, declined in 1938, when about 168,000,000 pounds were shipped abroad compared with about 184,000,000 pounds in 1937. The material increase in exports in 1937 was largely the result of military preparations in the totalitarian countries, particularly Germany. However, the decrease in 1938, being quite generally distributed over all the principal importing countries probably reflected a general slump in activity at rubber plants.

[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.

Compared with domestic prices foreign quotations held up well; the average export value dropped only 0.21 cent per pound, or from 4.72 cents per pound in 1937 to 4.51 per pound in 1938.

Important gains in exports to foreign countries were notably few in 1938. The outstanding gain of about 40 percent over 1937 was credited to Italy. The United Kingdom continued as the leading foreign customer, with France second and Germany third. Although Germany imported less carbon black from the United States in 1938 than in 1937 it is doubtful if the production of substitutes was responsible. The low prices for carbon black in 1938 were not conducive to the development of substitutes, even in Germany.

An irregular upward trend is noticeable in exports by months for 1938. The highest monthly total, about 18,000,000 pounds, was exported in December and the lowest, about 11,000,000 pounds, in April. Galveston (Houston) further consolidated its position as the leading shipping port in 1938.

Carbon black exported from the United States, 1936–38, by countries

Country	1936		1937		1938	
	Pounds	Value	Pounds	Value	Pounds	Value
Argentina	2, 214, 415	$120, 858	3, 115, 630	$163, 139	3, 203, 142	$151, 669
Australia	7, 525, 575	365, 178	9, 641, 002	516, 410	6, 952, 545	324, 118
Belgium	4, 791, 552	216, 690	5, 164, 255	234, 743	5, 459, 202	250, 475
Canada	14, 131, 366	634, 911	17, 171, 885	719, 631	13, 867, 345	372, 752
China	1, 998, 145	97, 202	1, 529, 855	76, 878	673, 498	32, 230
Czechoslovakia	258, 475	10, 429	2, 187, 100	91, 522	1, 834, 572	84, 395
France	26, 747, 904	1, 195, 879	29, 913, 980	1, 336, 934	26, 216, 610	1, 219, 450
Germany	16, 225, 511	733, 491	27, 441, 114	1, 172, 649	23, 646, 635	1, 076, 568
India, British	752, 754	31, 931	1, 002, 210	44, 198	949, 455	44, 340
Italy	5, 208, 663	239, 276	6, 956, 079	300, 972	9, 764, 699	440, 881
Japan	10, 918, 380	519, 919	11, 929, 498	619, 790	9, 172, 849	443, 483
Mexico	1, 006, 129	90, 832	1, 229, 597	56, 438	1, 396, 870	44, 444
Netherland India	496, 757	33, 319	853, 905	47, 055	1, 235, 515	57, 142
Netherlands	2, 789, 979	133, 973	3, 931, 601	176, 132	3, 643, 185	174, 052
Norway	459, 085	24, 148	453, 302	23, 018	560, 789	28, 088
Poland and Danzig	3, 080, 158	146, 531	2, 175, 159	103, 231	3, 166, 867	151, 361
Spain	1, 239, 449	59, 476	512, 200	21, 252	1, 332, 229	59, 357
Sweden	1, 425, 420	92, 229	1, 549, 753	86, 637	2, 714, 415	130, 083
Union of South Africa	1, 605, 210	67, 290	3, 155, 311	128, 449	1, 792, 986	75, 375
United Kingdom	46, 956, 730	2, 163, 893	48, 381, 173	2, 467, 609	44, 429, 105	2, 104, 878
Yugoslavia	22, 500	994	87, 600	5, 193	804, 735	39, 803
Other countries	4, 864, 241	272, 255	5, 870, 673	308, 203	5, 151, 068	274, 939
	154, 718, 398	7, 250, 704	184, 252, 882	8, 700, 083	167, 968, 316	7, 579, 883

Carbon black exported from the United States, 1937–38, by months and customs districts

Month	1937		1938		Customs district	1937		1938	
	Pounds	Value	Pounds	Value		Pounds	Value	Pounds	Value
Jan.	13, 638, 301	$644, 662	14, 869, 135	$766, 764	Buffalo	111, 589	$8, 891	89, 711	$7, 997
Feb.	15, 200, 283	685, 630	11, 083, 662	493, 070	Dakota	2, 958, 355	168, 184	588, 073	28, 312
Mar.	14, 758, 714	678, 877	14, 814, 670	654, 988	El Paso	1, 211, 100	54, 251	1, 344, 900	38, 617
Apr.	16, 880, 907	747, 700	10, 904, 372	459, 564	Galveston	116, 735, 117	5, 522, 563	120, 745, 454	5, 533, 374
May	17, 952, 516	837, 133	16, 807, 723	783, 212	Los Angeles	671, 659	37, 251	349, 312	14, 496
June	19, 276, 858	844, 481	12, 861, 809	553, 249	Michigan	16, 510, 469	682, 323	13, 453, 512	355, 969
July	13, 396, 762	607, 628	11, 443, 234	525, 217	New Orleans	42, 638, 203	2, 049, 594	27, 408, 556	1, 404, 677
Aug.	14, 754, 902	771, 265	12, 421, 213	538, 079	New York	330, 218	37, 851	112, 410	36, 746
Sept.	14, 454, 922	697, 240	13, 355, 141	607, 181	Sabine	2, 077, 838	89, 309	2, 369, 513	97, 018
Oct.	16, 053, 820	845, 780	16, 629, 738	776, 318	San Francisco	565, 956	29, 074	1, 152, 551	50, 094
Nov.	15, 017, 474	697, 987	14, 668, 039	640, 315	Vermont	329, 949	15, 032	192, 555	4, 488
Dec.	12, 867, 423	641, 700	18, 109, 580	781, 926	Other districts	112, 429	5, 760	161, 769	8, 095
	184,252,882	8,700,083	167,968,316	7,579,883		184, 252, 882	8, 700, 083	167, 968, 316	7, 579, 883

Imports of "gas black and carbon black," as reported by the Bureau of Foreign and Domestic Commerce, totaled 390 pounds valued at $30 in 1938 compared with 34 pounds valued at $2 in 1937. Imports of acetylene black, a competitor for certain uses, declined from 1,309,144 pounds valued at $139,904 in 1937 to 1,220,781 pounds valued at $127,889 in 1938.

STOCKS

As usual, the decline in demand proceeded faster than that in production, hence stocks increased. Stocks at the plants rose from 100,497,000 pounds the first of the year to 166,159,000 pounds on December 31. Although the gain in stocks was material and weakened the market, it was much less than the annual gains of 1929 and 1930; furthermore, overproduction was corrected to the extent that stocks actually declined in the last quarter of 1938. However, lest this statement be taken too optimistically it should be remarked that rubber manufacturers probably stocked up late in the year in anticipation of higher prices. On the other hand, stocks in the form of finished rubber goods held by manufacturers declined materially—as stocks of casings decreased from about 10,400,000 on December 31, 1937, to about 8,500,000 on December 31, 1938.

PRICES AND VALUES

Carbon-black prices in 1938 were distressing to producers; they reached unprecedented lows early in the year and never recovered in spite of greatly increased business in the last half of the year. The Zone A spot price declined on January 10 to less than 3 cents per pound, formerly considered the absolute minimum based on costs. On January 17 the price was cut an additional 0.25 cent (to 2.7 cents). It was raised to 2.75 cents on April 4, but this increase (0.05 cent) simply covered increased freight rates.

The weighted average f. o. b. price at plants fell from 3.41 cents in 1937 to 2.41 cents in 1938. The spread between the average spot price and the average value declined from about 0.90 cent per pound in 1937 to 0.34 cent in 1938.

Quoted prices on various grades of carbon black, 1937–38, 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
1938:														
Jan. 1	3.20	3.50	3.65	3.65	3.80	4.10	4.30	5.0	8.50	13.0	27.50	40.0	60.0	110.0
Jan. 10	2.95	3.25	3.40	3.40	3.55	3.85	4.05	------	------	------	------	------	------	------
Jan. 17	2.70	3.0	3.15	3.15	3.30	3.60	3.80	------	------	------	------	------	------	------
Mar. 28	------	------	------	------	------	------	------	3.75	------	------	------	------	------	------
Apr. 4	2.75	3.10	3.19	3.25	3.41	3.75	3.0	------	------	------	------	------	------	------
Average:														
1938	2.75	3.09	3.20	3.24	3.40	3.73	3.22	4.04	8.50	13.0	27.50	40.0	60.0	110.0
1937	4.31	4.61	4.76	4.76	4.91	5.21	4.56	5.11	8.60	13.1	27.62	40.1	60.0	110.0

[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, North Carolina, parts of New York, Pennsylvania, Rhode Island, South Carolina, Vermont, and Virginia.
Zone G: Mexico.

HELIUM

H. S. Kennedy and C. W. Seibel

SUMMARY OUTLINE

The expectation of wider use of helium has materialized. The act approved September 1, 1937 (50 Stat. 885), authorizes sale by the Bureau of Mines of helium not needed for Government use, upon payment in advance and under regulations approved by the President, for medical, scientific, and commercial use. Regulations were approved by the President on January 14, 1938, and amended with the President's approval on March 10, 1938. As a result of the enactment, helium may be purchased at reasonable prices from the Bureau of Mines, and it is likely that still greater impetus will be given to the use of helium. During the year 1938, the Bureau entered into 20 contracts with private parties for the sale of more than 800,000 cubic feet of helium.

The helium produced at the Bureau of Mines helium plant, Amarillo, Tex., is about 98.2 percent pure. The impurity is largely nitrogen. Under the regulations, the term "contained helium" is used to designate the actual quantity of helium contained in a mixture of that element and other gases. The regulations define the helium sold by the Bureau of Mines as "market helium," and this item is broken down into the specific uses "medical," "scientific," and "commercial." During the last fiscal year one charge was made for helium used for medical and scientific purposes, and a slightly higher charge was made for helium sold for commercial use.

Market helium is sold at approximately the cost of production, with a reasonable charge added to cover items of depreciation and depletion. The Government wishes to make helium available at the lowest reasonable price, and the regulations provide that the helium shall be sold at a price slightly greater than cost. The cost of producing helium varies with the quantity produced; as a result, the exact cost cannot be predetermined, because of the uncertain quantity required by commercial users. Therefore, it is necessary to require deposits in advance of deliveries to protect the Government from possible loss because of increased cost. These deposits are based on estimated charges for the helium itself and an amount to cover services independent of the actual production of helium performed by the Bureau for the purchasers. These service charges include expenses incident to the transportation of cylinders to and from railroad stations, filling cylinders, and repairing them when necessary.

The estimated cost for market helium for the fiscal year 1938 was $14.25 per thousand cubic feet. To protect the Government in the event of an unlooked-for advance in cost of production, a deposit of $17.10 was required of each purchaser for medical and scientific helium, and if the helium was to be used for commercial purposes, a deposit of $19.15 per thousand cubic feet was required. Under the terms of the regulations, any difference between the deposit (based on estimated cost) and the charges for helium and services (based on actual cost) is refunded to the purchaser at the end of the fiscal year, when the actual cost has been computed. The cost of production for the fiscal year 1938, as approved by the Secretary of the Interior, was $12.83 per thousand cubic feet, which resulted in a charge of $13.47 for helium used for medical and scientific purposes and of $15.08 for helium used commercially.

Pursuant to the Helium Act, helium is furnished to Government agencies on their requisition and payment of a proportional share of the expenses incident to the administration, operation, and maintenance of the properties. The proportionate share paid by Government agencies for the fiscal year 1938 was $11.16 per thousand cubic feet of helium received.

Uses.—The major use for helium still is for inflation of nonrigid airships. Both the Army and Navy have airships or observation balloons using helium, and during the past year Congress authorized the building of a new airship for the Navy Department. Moreover, the Goodyear Tire & Rubber Co. has continued to operate several of its small airships, which led to a contract for 500,000 cubic feet of helium during the year.

The use of larger and larger balloons by the Weather Bureau in determining wind direction and in radio-sonde observations for obtaining data used in weather predictions, has caused the replacement of explosive hydrogen with appreciable quantities of helium. Helium now is being furnished to approximately 120 stations of the Weather Bureau, and about 500,000 cubic feet of helium has been used since July 1, 1938, when helium was substituted for hydrogen. The Weather Bureau has expressed the desire to have all its stations use helium during the next fiscal year, which indicates a demand for approximately 1,500,000 cubic feet.

Before helium could be obtained from the Government, it sold at approximately $150 per thousand cubic feet when purchased in small quantities. Such a price made its use for medical purposes, except for wealthy persons, almost prohibitive. Helium can now be purchased from the Government at about one-tenth that selling price. However, helium by itself is not normally used for medical treatment; it is mixed with approximately 20 percent oxygen. The Government is not prepared to mix oxygen with the helium that it produces, and private individuals must purchase such mixtures from commercial distributors. However, it has been estimated that approximately 200,000 cubic feet of helium sold during the calendar year 1938 was used for medical purposes. This quantity of helium, according to authorities on the subject, is enough to furnish 20,000 patient-hours of treatment. Helium mixed with 20 percent oxygen and breathed by persons afflicted with asthma offers almost immediate relief, according to reports from the medical profession.

Recently a mixture of helium and oxygen has been tested with encouraging results in the treatment of sinus and Eustachian tube blockage. Men working in tunnels are subjected to air pressure before entering the tunnel face, and "blocks" occur in the Eustachian tubes if the men have a stoppage in these tubes due to sinus infection or colds. These tubes must be clear to permit the pressure on the outside and inside of the ear to equalize. If the tubes are not clear, severe pain prevents the men from working under pressure.

Approximately 5,000 cubic feet of helium has been delivered to the National Bureau of Standards for certain specific heat determinations. Small quantities have also been supplied to several universities and institutions for scientific research.

In 1925 the Bureau of Mines published Report of Investigations 2670, Possibilities in the Use of Helium-Oxygen Mixtures as a Mitigation of Caisson Disease, by R. R. Sayers, W. P. Yant, and J. H. Hildebrand and issued a press release in 1926 entitled, "Helium Helps the Diver." These reports dealt with research on the possibility of using helium-oxygen mixtures in deep-sea diving. The Navy Department has continued this research, and others are becoming increasingly interested in this subject. Within the past year new deep-sea diving records have been made possible through the use of helium-oxygen mixtures.

Cliffside gas field.—The four gas wells on the Government's Cliffside helium reserve produced a total of 361,065,000 cubic feet of helium-bearing natural gas during the fiscal year 1938, making a cumulative production for the field of 5,053,153,000 cubic feet to June 30, 1938.

Amarillo plant.—Although the Bureau of Mines Helium Plant continued to operate on intermittent schedule during the fiscal year 1938, the production of helium was almost 27 percent greater than that of 1937. The helium production for the fiscal year 1938 was 6,099,960 cubic feet, which makes a cumulative production of 84,260,165 cubic feet of helium produced in the plant from the beginning of production in April 1929 to June 30, 1938. During the first half of the current fiscal year, an additional 3,906,975 cubic feet of helium was produced, making a total production of 88,167,140 cubic feet of helium to December 31, 1938.

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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 3 percent from 1937 to 1938 and reduced their inventories 12 percent from December 31, 1937, to December 31, 1938. The entire increase was in domestic demand as exports of petroleum asphalt were 3 percent less in 1938 than in 1937. Imports of lake asphalt, grahamite, and petroleum asphalt dropped sharply; they comprised only 2 percent of the total demand in 1937 and less than 0.75 percent in 1938. Only 5 percent of the petroleum asphalt produced in the United States was sold to foreign countries in 1937 and only 4 percent in 1938.

Salient statistics of asphalt and related bitumens in the United States, 1937–38

	1937	1938
SUPPLY		
Native asphalt and related bitumens:		
Produced ... short tons	485, 384	512, 147
Imported (chiefly lake asphalt) ... do	28, 663	23, 645
Petroleum asphalt (excluding road oil):		
Produced at refineries from—		
Domestic petroleum ... do	2, 804, 121	3, 068, 631
Foreign petroleum ... do	1, 555, 803	1, 438, 245
	4, 359, 924	4, 506, 876
Imported	62, 720	9, 786
Stocks, Jan. 1 ... do	364, 199	557, 446
Total supply ... do	5, 300, 890	5, 609, 900
DISTRIBUTION		
Native asphalt and related bitumens:		
Indicated domestic demand ... short tons	466, 849	498, 601
Exports (unmanufactured) ... do	18, 535	13, 546
Petroleum asphalt (excluding road oil):		
Indicated domestic demand (including lake asphalt) ... do	4, 049, 303	4, 404, 846
Exports ... do	208, 757	202, 499
Stocks, Dec. 31 ... do	557, 446	490, 408
Total distribution	5, 300, 890	5, 609, 900

[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, 1937–38—Continued

	1937	1938
VALUES		
Native asphalt and related bitumens:		
Sales	$3,019,038	$3,065,260
Imports (chiefly lake asphalt)	395,882	378,209
Exports (unmanufactured)	720,358	543,509
Petroleum asphalt:		
Sales (excluding road oil) from—		
Domestic petroleum	25,478,565	25,948,928
Foreign petroleum	17,515,872	15,432,152
Total sales	42,994,437	41,381,080
Imports	260,132	38,883
Exports	3,111,127	3,030,162

NATIVE ASPHALT AND BITUMENS

Bituminous rock.—As a result of an apparent increase in the laying of high-type asphaltic pavements sales of bituminous rock by producers increased from 447,213 short tons valued at $2,035,410 in 1937 to 483,497 tons valued at $2,409,616 in 1938. Rock-asphalt operators in Kentucky and Alabama sold 159,276 tons valued at $865,818 in 1937 and 215,142 tons valued at $1,379,138 in 1938. On the other hand, sales by operators in Texas, Oklahoma, and New Mexico decreased from 265,895 tons valued at $1,075,832 in 1937 to 241,299 tons valued at $939,688 in 1938. Sales by producers in California and Kansas were higher in 1938 than in 1937, but sales in Missouri were slightly lower.

Gilsonite and wurtzilite.—Sales of gilsonite by producers in northeastern Utah decreased from 38,038 short tons valued at $973,007 in 1937 to 28,574 tons valued at $649,724 in 1938. A 10-percent increase in railroad freight rates and decreased demand for varnishes and printing ink reduced the domestic demand for gilsonite; higher steamship freight rates and exchange difficulties reduced sales of gilsonite in other countries.

Sales of wurtzilite decreased from 133 tons valued at $10,621 in 1937 to 76 tons valued at $5,920 in 1938.

Sulfonated bitumen.—In 1938, as in 1937, a small quantity of natural sulfonated bitumen was produced in Box Elder County, Utah, near Ogden.

Exports.—A decrease of 35 percent in demand from Europe, especially from France, Germany, and the United Kingdom, caused exports of natural asphalt and bitumen, unmanufactured, to decline from 18,535 short tons valued at $720,358 in 1937 to 13,546 tons valued at $543,509 in 1938. Of the total exports, 75 percent went to Europe both in 1937 and in 1938; 10 percent went to Canada in 1938 compared with 8 percent in 1937; 2 percent went to South America in 1938 compared with 7 percent in 1937; and 9 percent went to Asia, chiefly Japan, in 1938 compared with 7 percent in 1937.

MANUFACTURED OR PETROLEUM ASPHALT

Production.—Petroleum refineries produced 3 percent more asphalt in 1938 than in 1937. The total refinery output in 1938 included 165,440 tons of other petroleum products blended with the asphalt to produce commercial varieties of the required consistency.

Of the 1938 production of petroleum asphalt, 32 percent was made from foreign crude imported chiefly from Venezuela and Mexico compared with 36 percent in 1937. Runs of foreign petroleum to stills increased less than 1 percent—from 25,996,000 barrels in 1937 to 26,187,000 in 1938. However, as the recovery of asphalt from foreign crude decreased from 33 percent of foreign crude runs in 1937 to 30 percent in 1938, the production of asphalt from foreign oil decreased 8 percent—from 1,555,803 tons in 1937 to 1,438,245 in 1938. East Coast refineries manufactured 78 percent of their asphalt from foreign crude in 1938 compared with 81 percent in 1937, and Gulf Coast refineries made 16 percent of their asphalt from foreign crude in 1938 compared with 30 percent in 1937. At the same time the production of asphalt from domestic crude increased (especially in the refining districts west of the Mississippi River and in the Appalachian district, in spite of a decline in the Indiana, Illinois, Kentucky, etc., district) from 2,804,121 tons in 1937 to 3,068,631 in 1938.

Stocks.—To meet an increase of 355,543 short tons in the indicated domestic demand (offset to a slight extent by a decline of 6,258 tons in export demand) the petroleum refineries of the United States enlarged their output of asphalt 146,952 tons in 1938, while imports of lake asphalt, grahamite, and petroleum asphalt decreased 57,952 tons. Consequently, stocks of asphalt at refineries were 67,038 tons lower on December 31, 1938, than on December 31, 1937, in contrast with an increase of 193,247 tons during 1937. Decreases in asphalt inventories were general east of the Rocky Mountains but were greatest in the Indiana, Illinois, Kentucky, etc., and Louisiana-Arkansas districts.

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1938, by districts

District	Production	Other petroleum products blended	Receipts from other sources	Stocks	
				Dec. 31, 1937	Dec. 31, 1938
	Short tons	*Short tons*	*Short tons*	*Short tons*	*Short tons*
East Coast	1,691,540	62,226	23,834	141,738	134,136
Appalachian	113,206		1,928	17,877	14,789
Indiana, Illinois, Kentucky, etc.	605,710	26,867	10,730	152,766	108,897
Oklahoma, Kansas, and Missouri	341,435	1,295	7,715	56,692	40,220
Texas:					
Gulf Coast	210,156		1	14,043	15,451
Inland	195,764		15,521	28,146	24,863
Total, Texas	405,920		15,522	42,189	40,314
Louisiana-Arkansas:					
Louisiana Gulf Coast	229,750	13,002	6,346	38,080	34,068
Arkansas and Louisiana Inland	193,465	10,434	3,932	36,281	16,486
Total, Louisiana-Arkansas	423,215	23,436	10,278	74,361	50,554
Rocky Mountain	156,961	5,667	9,762	21,973	23,096
California	603,449	45,949	15,751	49,850	78,402
Total: 1938	4,341,436	165,440	95,520	557,446	490,408
1937	4,181,988	177,936	41,905	364,199	557,446

Production, receipts, stocks, consumption, transfers and losses, and sales of asphalt (exclusive of road oil) at petroleum refineries in the United States in 1938, by districts—Continued

District	Consumption by companies	Transfers and losses	Sales	
			Quantity	Value
	Short tons	*Short tons*	*Short tons*	
East Coast	3,640	6,818	1,774,744	$18,840,860
Appalachian	300		117,922	1,489,664
Indiana, Illinois, Kentucky, etc	21,083	13,720	652,373	6,509,542
Oklahoma, Kansas, and Missouri	8,474	197	358,246	2,485,080
Texas:				
Gulf Coast	47,936	1,518	159,295	1,412,779
Inland			214,568	1,402,950
Total, Texas	47,936	1,518	373,863	2,815,729
Louisiana-Arkansas:				
Louisiana Gulf Coast	744	23,747	228,619	2,153,334
Arkansas and Louisiana Inland	6	943	226,677	1,553,073
Total, Louisiana-Arkansas	750	24,690	455,296	3,706,407
Rocky Mountain	1,290	3,837	166,140	1,486,292
California	38,107	20,447	578,043	4,047,506
Total: 1938	121,580	71,227	4,476,627	41,381,080
1937	144,467	32,162	4,031,953	42,994,437

Sales.—Total sales of petroleum asphalt by refineries increased 11 percent in quantity but decreased 4 percent in value from 1937 to 1938. The average value at the refinery of asphalt sold in 1938 was $9.24 per short ton compared with $10.66 in 1937.

Highway construction absorbed more than three-fifths of all asphalt sold in 1938. In general, such statistics as are available indicate an increase in street and road construction in 1938 over 1937. Awards of street and road contracts exceeding $25,000, compiled by the Engineering News-Record, increased 54 percent in value (from $414,537,000 in 1937 to $637,862,000 in 1938)—about 55 percent in volume if allowance is made for a slight decrease in construction costs from 1937 to 1938. The average mileage under construction under the supervision of the Bureau of Public Roads increased from 8,062 in 1937 to 8,140 in 1938. The total mileage of State highways (including Federal-aid roads completed) increased from 30,632 in 1937 to 30,977 in 1938, according to the American Association of State Highway Officials. However, average employment for construction and maintenance of Federal and State highways, as reported to the Bureau of Public Roads, decreased from 281,086 in 1937 to 273,055 in 1938.

Asphalt and asphaltic material (exclusive of road oil) sold at petroleum refineries in the United States in 1938, 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	793, 879	$6, 615, 133	477, 959	$5, 073, 578	1, 271, 838	$11, 688, 711
Roofing	463, 252	4, 413, 206	298, 473	3, 189, 638	761, 725	7, 602, 844
Waterproofing	14, 870	167, 745	47, 651	520, 208	62, 521	687, 953
Blending with rubber	6, 394	69, 536	17, 420	226, 484	23, 814	296, 020
Briquetting	56, 822	597, 832	919	13, 416	57, 741	611, 248
Mastic and mastic cake	906	7, 929	611	6, 245	1, 517	14, 174
Pipe coatings	12, 403	143, 837	2, 647	32, 488	15, 050	176, 325
Molding compounds	10, 343	115, 135	1, 582	16, 772	11, 925	131, 907
Miscellaneous uses	58, 890	711, 054	42, 761	478, 579	101, 651	1, 189, 633
	1, 417, 759	12, 841, 407	890, 023	9, 557, 408	2, 307, 782	22, 398, 815
Semisolid and liquid products of more than 200 penetration:[1]						
Flux for:						
Paving	121, 796	839, 365	71, 908	658, 370	193, 704	1, 497, 735
Roofing	307, 751	2, 074, 976	58, 159	581, 136	365, 910	2, 656, 112
Waterproofing	3, 239	42, 810	6, 190	55, 710	9, 429	98, 520
Cut-back asphalts:						
Rapid-curing	538, 390	5, 194, 927	354, 520	3, 934, 335	892, 910	9, 129, 262
Medium-curing	476, 363	3, 617, 180	23, 724	211, 538	500, 087	3, 828, 718
Emulsified asphalts and fluxes	43, 907	550, 945	13, 046	127, 834	56, 953	678, 779
Paints, enamels, japans, and lacquers	13, 218	173, 121	12, 204	114, 766	25, 422	287, 887
Other liquid products	104, 540	614, 197	19, 890	191, 055	124, 430	805, 252
	1, 609, 204	13, 107, 521	559, 641	5, 874, 744	2, 168, 845	18, 982, 265
Total: 1938	3, 026, 963	25, 948, 928	1, 449, 664	15, 432, 152	4, 476, 627	41, 381, 080
1937	2, 476, 454	25, 478, 565	1, 555, 499	17, 515, 872	4, 031, 953	42, 994, 437

[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.

The increase in mileage of State highways built during 1938 over 1937 was in the higher and intermediate types of surface and in grading and draining operations. Construction of the lighter types of surface declined 7 percent from 1937 to 1938. Asphaltic types (asphaltic concrete, asphaltic macadam, and low-cost bituminous mixtures) gained 22 percent from 1937 to 1938—they constituted 70 percent of the mileage of higher and intermediate types laid on State highways in 1937 and 78 percent in 1938. On the other hand, the total mileage of portland-cement concrete and of brick and block pavement declined 21 percent from 1937 to 1938.

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 general increase in the yardage of municipal street paving, especially in the larger cities, an important but little-recorded field of demand.

Increases in road and street contracts awarded were general throughout the United States but were greatest in the Pacific States, the States lying between the Rocky Mountain front and the Mississippi River, and the Middle Atlantic States. The greatest increase in construction of asphaltic types of pavement was in low-cost bituminous surfaces—from 6,932 miles in 1937 to 9,077 in 1938. Eighty-five percent of this mileage was laid in the less densely populated States west of the Mississippi River and south of the Ohio and Potomac Rivers. A striking increase in the construction of low-cost bituminous surfaces in Indiana raised the proportion of the States bordering the Great Lakes from 10.5 percent of the National total in 1937 to 21 percent in 1938. Asphaltic-macadam paving construction decreased from 574 miles in 1937 to 487 in 1938. Fifty-one percent was laid east of the Mississippi River in 1937 and 80 percent in 1938. Asphaltic-concrete (including sheet-asphalt and natural-rock-asphalt) pavement construction decreased from 1,291 miles in 1937 to 1,137 in 1938. Of this more expensive type of pavement, 87 percent was laid east of the Mississippi River in 1937 and 67 percent in 1938.

Increased construction of high-type, hard-surfaced streets and highways is indicated by a 9-percent gain in sales of paving asphalt of less than 200 penetration from 1,162,497 short tons in 1937 to 1,271,838 in 1938. Gains in sales in the East Coast district—from 625,652 tons in 1937 to 668,301 in 1938—in the Gulf Coast districts of Texas and Louisiana—from 121,258 tons in 1937 to 139,807 in 1938—and in the Inland districts of Texas and Arkansas and Louisiana—from 79,200 tons in 1937 to 154,879 in 1938—more than offset declines in California—from 209,062 tons in 1937 to 190,063 in 1938—and in the Indiana, Illinois, Kentucky, etc., district—from 80,010 tons in 1937 to 67,384 in 1938.

Sales of paving asphalt made from foreign petroleum decreased from 490,873 tons in 1937 to 477,959 in 1938, and sales of paving asphalt made from domestic crude increased from 671,624 tons in 1937 to 793,879 in 1938.

Sales of paving flux increased from 130,616 tons in 1937 to 193,704 in 1938. The principal gains were in the East Coast district (from 48,437 tons in 1937 to 73,635 in 1938) and in California (from 45,418 tons in 1937 to 61,623 in 1938). Smaller gains were recorded in the Indiana, Illinois, Kentucky, etc., district, in Texas, and in the Louisiana-Arkansas district.

Extensive 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 27-percent increase in sales from 1,099,498 tons in 1937 to 1,392,997 in 1938. The gains were greater west of the Mississippi River; only the Texas Gulf Coast district furnished an exception to the general increase over the United States. As in 1937, the greatest increase was in the Oklahoma, Kansas, and Missouri district (from 165,916 tons in 1937 to 253,253 in 1938). This district was followed by the Rocky Mountain district (from 100,341 tons in 1937 to 149,448 in 1938); the Indiana, Illinois, Kentucky, etc., district (from 160,695 tons in 1937 to 205,222 in 1938); the East Coast district (from 393,970 tons in 1937 to 434,599 in 1938); and Inland Texas (from 94,419 tons in 1937 to 138,477 in 1938). Of the major districts producing cut-back asphalts, California made the lowest gain—from 105,812 tons in 1937 to 123,428 in 1938.

The greater increase was in sales of rapid-curing cut-backs—from 673,035 tons valued at $7,948,608 in 1937 to 892,910 valued at $9,129,262 in 1938. At the same time sales of medium-curing cut-backs increased in quantity from 426,463 tons in 1937 to 500,087 in 1938 but declined in value from $4,307,229 to $3,828,718.

The upward trend in sales of asphalt emulsions was interrupted in 1938. Petroleum refineries sold 56,654 tons (13,346,799 gallons) valued at $754,437 in 1937 and 56,953 tons (13,417,238 gallons) valued at $678,779 in 1938. In addition, 49,336,367 gallons valued at $4,339,596 were sold in 1937 and 43,928,186 gallons valued at $3,659,258 in 1938 by six major industrial companies that purchased asphalt from petroleum refineries. Accordingly, total known sales of emulsified asphalts and fluxes decreased in quantity from 62,683,166 gallons in 1937 to 57,345,424 in 1938 and in value from $5,094,033 in 1937 to $4,338,037 in 1938.

Roofing manufacture furnished the second-largest demand for asphalt, absorbing 27 percent of the total sales in 1937 and 25 percent in 1938. A 16-percent rise in shipments of prepared roofing and asphalt siding reported by the Bureau of the Census—from a total of 30,461,447 squares in 1937 to 35,238,029 in 1938—was reflected in a 3-percent rise in sales of roofing asphalt and roofing flux combined—from 1,091,202 tons in 1937 to 1,127,635 in 1938. The principal gains occurred west of the Mississippi River. Texas refineries increased their sales of roofing asphalt and roofing flux from 46,894 tons in 1937 to 92,885 in 1938. Refineries of Louisiana and Arkansas sold 122,290 tons of roofing asphalt and roofing flux combined in 1937 and 132,715 in 1938. In the Oklahoma, Kansas, and Missouri district sales of roofing asphalt and flux increased from 40,328 tons in 1937 to 65,345 in 1938. In California the gain was smaller—from 75,224 tons in 1937 to 77,998 in 1938. On the other hand, refineries of the Indiana, Illinois, Kentucky, etc., district decreased their sales of roofing asphalt and flux from 309,870 tons in 1937 to 289,809 in 1938 and East Coast refineries from 460,984 tons in 1937 to 421,128 in 1938.

A 3-percent decline in the total floor space of both residential and nonresidential contracts awarded, as estimated by the F. W. Dodge Corporation for 37 States, was accentuated in sales of waterproofing asphalt and flux, which decreased from 115,681 tons in 1937 to 71,950 in 1938.

In response to a 13-percent drop in the manufacture of coal briquets, sales of briquetting asphalt fell 9 percent—from 63,767 tons in 1937 to 57,741 in 1938.

The decrease of 11 percent in sales of asphalt for blending with rubber—from 26,713 tons in 1937 to 23,814 in 1938—may be attributed chiefly to a 24-percent decline in the demand for rubber from 1937 to 1938.

DOMESTIC DEMAND

The indicated domestic demand for petroleum asphalt (including small quantities of imported lake asphalt and grahamite) was 9 percent greater in 1938 than in 1937, increasing from 337,442 short tons per month in 1937 to 367,070 in 1938.

In terms of the long-time trend the indicated demand was 23 percent above the expected demand for 1938, whereas it was 17 percent above the expected demand for 1937; that is, if the national demand had continued the average rate of growth it manifested from 1908 to 1936 it would have averaged 289,136 tons a month in 1937 and 297,864 in 1938. If these averages are used as a standard of comparison, the indicated demand of 337,442 tons a month in 1937 was 117 percent of the expected demand (289,136 tons), and the indicated demand of 367,070 tons a month in 1938 was 123 percent of the expected demand (297,864 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 1; from 1936 to 1938, 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.

In the first quarter of 1938 the indicated demand averaged 118 percent of the long-time trend multiplied by seasonal factors compared with 105 percent in the first 3 months of 1937. In the second quarter of 1938 it declined to 116 percent of the expected demand for these months compared with 119 percent during the second quarter of 1937. From July to September 1938 the demand was highest, averaging 133 percent of the expected demand compared with 132 percent in the same months of 1937. In the last quarter of 1938 the indicated demand averaged 122 percent of the expected demand compared with 99.7 percent in the last 3 months of 1937.

Relation of indicated asphalt demand to basic trend multiplied by seasonal factors, 1937–38

Month	1937			1938		
	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	169,202	150,772	89.1	174,310	229,001	131.4
February	155,295	176,207	113.5	159,983	153,342	95.9
March	199,128	222,806	111.9	205,139	254,351	124.0
April	273,002	281,437	103.1	281,243	297,329	105.7
May	335,860	406,235	121.0	345,999	398,654	115.2
June	373,940	479,223	128.2	385,228	475,112	123.3
July	384,754	498,228	129.5	396,368	478,289	120.7
August	399,789	501,023	125.3	411,856	581,820	141.2
September	384,348	541,176	140.8	395,950	541,739	136.8
October	376,368	399,829	106.2	387,730	489,368	126.2
November	240,821	263,247	109.3	248,091	310,373	125.1
December	177,125	129,120	72.9	182,471	195,468	107.1
	3,469,632	4,049,303	116.7	3,574,368	4,404,846	123.2

DISTRIBUTION BY RAIL

The tonnage of asphalt (natural, byproduct, or petroleum) terminated by class I railroads in the United States decreased from 4,337,548 short tons in 1937 to 4,295,232 in 1938, according to freight-commodity statistics compiled by the Interstate Commerce Commission. The principal decreases occurred east of the Mississippi River and Lake Michigan and north of the Ohio and Potomac Rivers; in general, more asphalt was terminated by class I railroads west of the Mississippi River and south of the Ohio and Potomac Rivers in 1938 than in 1937.

Forty-nine 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 2,400,706 short tons of asphalt in this district in 1937 and 2,418,722 tons in 1938. In the Southeastern district, lying south of the Potomac and Ohio Rivers and east of the Mississippi and Pearl Rivers, land deliveries of asphalt increased from 531,230 tons in 1937 to 663,802 tons in 1938. 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 339,443 tons in 1937 to 372,610 tons in 1938. In the North Central district, lying between the Great Lakes and the Rocky Mountain front, 632,554 tons were delivered in 1937 and 677,478 tons in 1938. In the Pacific-Rocky Mountain district, lying west of Great Falls, Cheyenne, Denver, Albuquerque, and El Paso, the tonnage of asphalt terminated increased from 612,230 tons in 1937 to 768,773 in 1938.

Supply and distribution of asphalt (petroleum, lake, and natural rock), exclusive of road oil, in continental United States in 1938, by districts, in short tons

	Northeastern district	Southeastern district	Southwestern district	North Central district	Pacific-Rocky Mountain district
Produced within district	1,916,617	597,854	1,401,801	-----	1,102,751
Imported	26,087	3,929	3,275	41	30
Received by rail from—					
Northeastern district	-----	40,000	5,000	302,896	-----
Southeastern district	329,372	-----	-----	-----	-----
Southwestern district	165,000	259,682	-----	325,438	58,000
Pacific-Rocky Mountain district	28,000	-----	24,545	50,000	-----
Net receipts by water	283,075	89,482	8,017	-----	-----
Withdrawn from stocks	62,097	3,462	31,154	-----	-----
	2,810,248	994,409	1,473,792	678,375	1,160,781
Shipped by rail—					
Within district	2,210,284	582,581	275,316	677,478	549,573
To Northeastern district	-----	329,372	165,000	-----	28,000
To Southeastern district	40,000	-----	259,682	-----	-----
To Southwestern district	5,000	-----	-----	-----	24,545
To North Central district	302,896	-----	325,438	-----	50,000
To Pacific-Rocky Mountain district	-----	-----	58,000	-----	-----
Shipped by motortruck, minor railroads, and intraport	208,438	81,221	97,294	-----	219,200
Net shipments by water	-----	-----	220,752	-----	159,822
Exported	43,630	1,235	72,310	897	99,966
Added to stocks	-----	-----	-----	-----	29,675
	2,810,248	994,409	1,473,792	678,375	1,160,781

FOREIGN TRADE

Imports.—Imports of natural asphalt and bitumen into the United States declined from 28,663 short tons valued at $395,882 in 1937 to 23,645 valued at $378,209 in 1938. Imports of lake asphalt from Trinidad decreased from 24,790 tons valued at $239,697 in 1937 to 19,396 valued at $205,038 in 1938. On the other hand, imports of grahamite from Cuba rose from 3,162 tons valued at $52,024 in 1937 to 3,826 valued at $65,344 in 1938.

Atlantic coast ports (chiefly New York) received 16,320 tons of natural asphalt and bitumen and Gulf coast ports (Mobile, New Orleans, and Galveston) 7,204 tons in 1938.

Imports of petroleum asphalt, including cut-backs, and road oil decreased from 344,960 barrels (62,720 short tons) valued at $260,132 in 1937 to 53,822 barrels (9,786 tons) valued at $38,883 in 1938. Of the 1938 imports, 53,449 barrels received in the customs district of Philadelphia came from Mexico and 373 barrels received in the customs district of Puerto Rico came from the Netherlands.

Exports.—Resuming the downward trend manifested since 1928, exports of petroleum asphalt were 3 percent smaller in 1938 than in 1937. Although foreign sales of unmanufactured petroleum asphalt increased from 41,299 short tons valued at $657,894 in 1937 to 42,290 valued at $734,683 in 1938, sales of manufactures of petroleum asphalt to other countries decreased from 167,458 tons valued at $2,453,233 in 1937 to 160,209 valued at $2,295,479 in 1938. As most of these manufactures were simply processed forms of asphalt, the exports of manufactured and unmanufactured asphalt in 1937 and 1938 have been combined in the following table for comparison with the 1936 exports that were not so differentiated.

The principal decreases were in sales to eastern and southern Asia, especially China, Japan, British Malaya, British India, and Ceylon. On the other hand, more asphalt was sold to Australia, New Zealand, and French Indochina. Less asphalt was shipped from the United States to the Union of South Africa and Mozambique in 1938 than in 1937. However, the decreases in exports of asphalt to eastern Asia and the Indian Ocean region were partly compensated by increases in sales to other countries of North America, to South America, and to the United Kingdom.

Petroleum asphalt exported from the United States, 1936–38, by countries

Country	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	3,695	$75,171	5,264	$105,585	11,565	$120,589
Other North America	5,803	86,475	6,076	96,119	12,015	202,144
	9,498	161,646	11,340	201,704	23,580	322,733
South America:						
Argentina	226	5,246	268	6,361	451	9,400
Brazil	5,823	76,686	8,210	105,367	8,459	123,633
Other South America	2,136	30,256	2,209	35,820	6,951	131,892
	8,185	112,188	10,687	147,548	15,861	264,925

Petroleum asphalt exported from the United States, 1936–38, by countries—Cont.

Country	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Europe:						
Belgium	2,697	$37,246	1,751	$24,018	2,924	$38,928
Denmark	26	1,157	75	1,762	118	3,867
France	4,556	71,014	4,461	68,441	4,010	52,187
Germany	682	17,078	603	14,347	354	8,832
Italy	27,830	395,017	3,559	52,808	32	661
Netherlands	1,049	14,872	1,121	17,585	578	8,331
Spain	337	6,309	----------	----------	56	2,714
United Kingdom	20,829	399,820	21,156	364,277	29,222	455,126
Other Europe	4,227	70,041	3,355	61,574	3,746	66,492
	62,233	1,012,554	36,081	604,812	41,040	637,138
Asia:						
British Malaya	8,791	134,276	16,776	221,882	9,508	174,017
Ceylon	2,295	27,528	6,593	86,264	3,453	49,504
China	7,348	100,724	7,956	123,054	2,153	31,699
Hong Kong	2,014	30,644	3,244	46,030	2,642	38,788
India, British	13,894	192,920	24,736	353,923	10,427	149,979
Indochina	8,458	107,588	5,621	54,989	5,809	85,590
Japan	3,858	51,591	4,908	75,983	1,964	30,172
Netherland India	17,903	238,506	17,323	238,965	13,022	190,183
Philippine Islands	10,695	122,226	11,627	143,973	11,367	150,427
Other Asia	861	13,549	169	4,661	2,493	42,878
	76,117	1,019,552	98,953	1,349,724	62,838	943,237
Africa:						
Mozambique	8,758	151,712	6,985	124,046	5,391	96,465
Tunisia	59	1,060	19	437	----------	----------
Union of South Africa	12,964	198,950	16,079	279,249	11,567	195,501
Other Africa	833	13,987	400	7,457	1,700	30,420
	22,614	365,709	23,483	411,189	18,658	322,386
Oceania:						
Australia	6,536	92,608	21,977	299,079	32,510	436,460
New Zealand	4,582	59,018	6,105	95,209	7,787	100,199
Other Oceania	738	11,898	131	1,862	225	3,084
	11,856	163,524	28,213	396,150	40,522	539,743
	190,503	2,835,173	208,757	3,111,127	202,499	3,030,162

ROAD OIL

Decreased construction of oil-treated macadam, gravel, and sand-clay highways resulted in a decline of 9 percent in refinery sales of road oil—from 8,733,650 barrels in 1937 to 7,904,890 in 1938. As a result of lower prices, the value at the refineries of sales of road oil decreased 20 percent—from $12,183,213 in 1937 to $9,704,689 in 1938. The declines were greatest in the following districts: California, Arkansas and Louisiana Inland; Indiana, Illinois, Kentucky, etc.; Rocky Mountain; and East Coast. Gains in the Oklahoma, Kansas, and Missouri district, the Appalachian district, and the Louisiana Gulf Coast district were insufficient to offset the general decline.

Of the road oil sold in 1938 only 632,423 barrels valued at $1,080,699 were made from foreign petroleum, imported chiefly from Venezuela and Mexico. Of the road oil made from foreign crude, 77 percent was sold by refineries of the Atlantic Coast district in 1937 and 76 percent in 1938; the remainder was sold by Gulf Coast refineries of Louisiana and Texas.

Road oil sold by petroleum refineries in the United States, 1937–38, by districts

District	1937		1938	
	Barrels	Value	Barrels	Value
East Coast	1,041,454	$1,718,132	943,073	$1,544,169
Appalachian	43,135	91,308	146,066	185,542
Indiana, Illinois, Kentucky, etc.	1,876,768	2,753,226	1,751,411	2,390,213
Oklahoma, Kansas, and Missouri	707,032	835,275	919,151	841,264
Texas:				
Gulf Coast	289,861	486,350	239,555	360,295
Inland	2,843	3,432	2,139	2,713
Total, Texas	292,704	489,782	241,694	363,008
Louisiana-Arkansas:				
Louisiana Gulf Coast	133,922	182,502	176,476	264,355
Arkansas and Louisiana Inland	395,171	457,024	129,828	170,048
Total, Louisiana-Arkansas	529,093	639,526	306,304	434,403
Rocky Mountain	1,245,266	2,494,609	1,183,880	1,492,280
California	2,998,198	3,161,355	2,413,311	2,453,810
Grand total	8,733,660	12,183,213	7,904,890	9,704,689

Petroleum refineries in the United States reported the production of 7,542,755 barrels of road oil in 1938 compared with 8,087,231 in 1937. The refinery output of road oil in 1938 was augmented by 722,100 barrels of other petroleum products, chiefly fuel oil, transferred to road-oil stocks compared with 1,089,167 barrels similarly transferred in 1937. Stocks of road oil and transferred oils held at refineries decreased 44,296 barrels during 1938, whereas they increased 127,804 barrels during 1937. Consumption of road oil at refineries in operations, transfers, losses, and adjustments were 404,261 barrels in 1938 compared with 314,944 in 1937.

The average value of road oil sold in the United States f. o. b. refinery fell from $1.39 in 1937 to $1.23 in 1938. The principal decreases were in the Appalachian district (from $2.12 per barrel in 1937 to $1.27 in 1938), in the Rocky Mountain district (from $2.00 to $1.26), in the Oklahoma, Kansas, and Missouri district (from $1.18 to $0.92), in the Indiana, Illinois, Kentucky, etc., district (from $1.47 to $1.36), and in the Texas Gulf Coast district (from $1.68 to $1.50). Gains in Inland Texas (from $1.21 to $1.27), in the Gulf Coast of Louisiana (from $1.36 to $1.50), and in Arkansas and Louisiana Inland ($1.16 to $1.31) were insufficient to check the general decline.

CEMENT

By Oliver Bowles and E. V. Balser

SUMMARY OUTLINE

Production of portland cement in the United States in 1938 declined to 105,357,000 barrels and shipments to 106,324,127 barrels valued at $153,977,226, according to final annual reports submitted by cement companies to the Bureau of Mines. The preliminary figures on production and shipments for 1938, published by the Bureau of Mines in January 1939, were each 0.2 percent greater than the final figures. The final figures represent a decline of 9 percent in production, 7 percent in shipments, and 9 percent in mill value of shipments compared with 1937. For the first 5 months of 1938 shipments were 13 percent lower than for the same period of 1937. Thereafter the decline from the corresponding months of 1937 was smaller, but not until October did shipments in 1938 exceed those in 1937.

The Federal Reserve Board annual index for cement production in 1938 was 71 compared with 65 for the durable-goods industries and 64 for the construction industries. Corresponding figures for 1937 were cement 78, durable-goods industries 109, and construction industries 59.

The average factory value was $1.45 a barrel in 1938 compared with $1.48 a barrel in 1937.

Shipments included 3,385,523 barrels of high-early-strength portland cement valued at $6,247,699, an average of $1.85 a barrel, in 1938 compared with 3,845,314 barrels valued at $7,134,468, an average of $1.86 a barrel, in 1937.

The quantity of natural, masonry (natural), and puzzolan cements produced decreased 10 percent and shipments 7 percent compared with 1937. The value of shipments of these varieties declined 1 percent.

The following tables present the outstanding features of the cement industry during recent years.

Salient statistics of the cement industry in the United States, 1935–38

	1935	1936	1937	1938
Domestic production:				
Portland ... barrels	76,741,570	112,649,782	116,174,708	105,357,000
Masonry, natural, and puzzolan (slag-lime) barrels	1,006,064	1,819,488	1,900,643	1,704,662
Total production ... do	77,747,634	114,469,270	118,075,351	107,061,662
Active plants:				
Portland ... number	150	149	150	151
Masonry, natural, and puzzolan (slag-lime) number	13	13	12	11
Domestic shipments:				
Portland ... barrels	75,232,917	112,849,979	113,804,782	106,324,127
Value	$113,372,182	$170,415,302	$168,835,208	$153,977,226
Masonry, natural, and puzzolan (slag-lime) barrels	1,011,411	1,760,993	1,873,400	1,745,541
Value	$1,437,542	$2,362,396	$2,578,885	$2,558,077
Total shipments ... barrels	76,244,328	114,610,972	115,678,182	108,069,668
Value	$114,809,724	$172,777,698	$171,414,093	$156,535,303
Imports ... barrels	619,404	1,658,902	1,803,932	1,727,411
Exports ... do	416,099	334,673	378,554	558,226
Apparent consumption ... do	76,447,633	115,935,201	117,103,560	109,238,853
Stocks at mills at end of year:				
Portland:				
Finished cement ... do	23,064,563	22,568,685	24,938,612	23,946,118
Clinker ... do	5,226,000	5,564,000	6,342,000	5,282,000
Masonry, natural, and puzzolan (slag-lime) barrels	172,572	230,788	258,031	196,649

Principal hydraulic cements produced and shipped in the United States, 1933–38

Year	Production					
	Active plants	Portland cement (barrels)	Masonry, natural, and puzzolan (slag-lime) cements		Total	
			Active plants	Barrels	Active plants	Barrels
1933	152	63,473,189	13	511,201	165	63,984,390
1934	150	77,747,765	14	671,588	164	78,419,353
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	11	1,704,662	162	107,061,662

Year	Shipments					
	Portland cement		Masonry, natural, and puzzolan (slag-lime) cements		Total	
	Barrels	Value	Barrels	Value	Barrels	Value
1933	64,282,756	[1] $85,583,916	477,761	$644,750	64,760,517	[1] $86,228,666
1934	75,901,279	116,921,084	678,204	960,732	76,579,483	117,881,816
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	1,745,541	2,558,077	108,069,668	156,535,303

[1] Corrected figures.

PORTLAND CEMENT

PRODUCTION, SHIPMENTS, AND STOCKS

Portland cement is the product that is obtained by pulverizing to a fine consistency a clinker produced by calcining to incipient fusion an intimate mixture of properly proportioned argillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control setting and certain other properties. Such additions, which usually comprise about 3 to 3½ percent by weight of the calcined product, consist principally of gypsum or mixtures of gypsum and anhydrite. The principal combinations of raw materials are (1) limestone with clay or shale, (2) cement rock (argillaceous limestone) either alone or with high-calcium limestone, (3) blast-furnace slag and limestone, (4) marl and clay, and (5) oyster shells and clay.

Some years ago all portland cement had fairly constant and uniform properties; in other words, there was only one standard portland cement. In 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. Statistics for all varieties are given in the general tables covering portland cement, 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 to be distinguished from certain other types, such as natural and slag-lime cements, which are quite distinct from portland cement and are covered in a separate section of this chapter.

The following tables present the principal statistics of portland cement. In the first table, relating 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 a 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 on annual reports of the producers, they reflect accurately the seasonal fluctuations in the industry.

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Portland cement produced, shipped, and in stock in the United States, 1937–38, by States and districts

	Active plants		Production			Shipments							Stock at mills (Dec. 31)		
			Barrels		Increase or decrease, 1938 (percent)	1937		1938		Average factory value per barrel		Increase or decrease in quantity, 1938 (percent)	Barrels		Increase or decrease, 1938 (percent)
	1937	1938	1937	1938		Barrels	Value	Barrels	Value	1937	1938		1937	1938	
STATE															
Alabama	5	6	4,415,141	4,627,639	+5	4,403,459	$6,165,974	4,548,079	$6,114,246	$1.40	$1.34	+3	595,959	675,520	+13
California	10	10	11,953,986	10,513,067	−12	11,877,642	17,900,739	10,539,010	15,689,210	1.51	1.49	−11	1,506,557	1,475,460	−2
Illinois	4	4	5,246,102	3,959,932	−25	4,713,734	6,756,747	4,357,119	5,993,644	1.43	1.38	−8	1,230,203	833,017	−32
Iowa	5	5	4,706,094	4,726,517	+.4	4,598,453	7,046,021	4,759,390	7,327,048	1.53	1.54	+3	1,569,787	1,536,914	−2
Kansas	6	6	3,696,507	3,264,350	−12	3,500,684	5,482,851	3,217,497	4,949,018	1.57	1.54	−8	1,034,619	1,081,375	+5
Michigan	11	11	8,180,969	7,159,362	−12	7,831,880	9,836,999	7,192,511	8,767,859	1.26	1.22	−8	2,110,936	2,077,781	−2
Missouri	5	5	4,756,285	4,491,458	−6	4,565,448	7,041,016	4,570,389	6,871,120	1.54	1.50	+.1	1,055,803	976,873	−7
New York	10	10	5,912,772	5,807,731	−2	6,106,083	8,825,785	5,720,922	7,893,270	1.45	1.38	−6	1,517,879	1,598,184	+5
Ohio	9	9	5,699,695	5,188,477	−9	5,501,769	7,771,268	5,258,603	7,094,745	1.41	1.35	−4	1,749,136	1,665,540	−5
Pennsylvania	26	25	23,064,465	20,868,384	−10	22,952,603	31,917,831	21,082,966	28,242,913	1.39	1.34	−8	5,627,030	5,412,451	−4
Tennessee	6	6	3,081,215	3,318,797	+8	3,013,817	4,683,717	3,390,871	5,063,628	1.55	1.49	+13	605,448	533,387	−12
Texas	9	10	6,906,453	6,949,164	+.6	6,687,719	11,488,866	7,116,545	11,885,494	1.72	1.67	+6	947,884	780,502	−18
Other States [1]	44	44	28,555,024	24,482,122	−14	28,051,491	43,917,394	24,570,225	38,085,031	1.57	1.55	−12	5,387,371	5,299,114	−2
	150	151	116,174,708	105,357,000	−9	113,804,782	168,835,208	106,324,127	153,977,226	1.48	1.45	−7	24,938,612	23,946,118	−4
DISTRICT															
Eastern Pennsylvania, New Jersey, and Maryland	23	22	21,195,678	19,895,691	−6	21,208,823	29,218,161	19,825,160	26,222,912	1.38	1.32	−7	4,513,213	4,583,747	+2
New York and Maine	11	11	6,370,647	6,245,193	−2	6,528,262	9,523,312	6,184,521	8,631,618	1.46	1.40	−5	1,653,706	1,707,874	+3
Ohio, western Pennsylvania, and West Virginia	18	18	10,787,616	9,374,184	−13	10,579,782	15,054,581	9,632,020	13,073,949	1.42	1.36	−9	3,404,459	3,133,153	−8
Michigan	11	11	8,180,969	7,159,362	−12	7,831,880	9,836,999	7,192,511	8,767,859	1.26	1.22	−8	2,110,936	2,077,781	−2
Wisconsin, Illinois, Indiana, and Kentucky	11	11	12,748,994	9,930,734	−22	11,723,854	17,419,152	10,760,293	15,454,526	1.49	1.44	−8	2,937,506	2,107,791	−28
Virgina, Tennessee, Alabama, Georgia, Florida, and Louisiana	17	18	11,017,080	12,026,249	+9	11,084,366	16,405,721	12,020,082	17,326,540	1.48	1.44	+8	1,806,111	1,812,294	+.3
Eastern Missouri, Iowa, Minnesota, and South Dakota	11	11	10,675,595	9,994,563	−6	10,294,618	15,788,687	10,190,025	15,572,640	1.53	1.53	−1	2,942,357	2,746,895	−7

Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	12	12	8, 651, 217	7, 602, 704	−12	8, 342, 027	12, 932, 031	7, 442, 529	11, 304, 784	1. 55	1. 52	−11	1, 942, 457	2, 102, 536	+8
Texas	9	10	6, 906, 453	6, 949, 164	+. 6	6, 687, 719	11, 488, 866	7, 116, 545	11, 885, 494	1. 72	1. 67	+6	947, 884	780, 502	−18
Colorado, Montana, Utah, Wyoming, and Idaho	8	8	3, 056, 597	2, 689, 465	−12	3, 000, 825	5, 929, 894	2, 705, 161	5, 365, 567	1. 98	1. 98	−10	625, 369	609, 674	−3
California	10	10	11, 953, 986	10, 513, 067	−12	11, 877, 642	17, 900, 739	10, 539, 010	15, 689, 210	1. 51	1. 49	−11	1, 506, 557	1, 475, 460	−2
Oregon and Washington	9	9	4, 629, 876	2, 976, 624	−36	4, 644, 984	7, 337, 065	2, 716, 270	4, 682, 127	1. 58	1. 72	−42	548, 057	808, 411	+48
	150	151	116, 174, 708	105, 357, 000	−9	113, 804, 782	168, 835, 208	106, 324, 127	153, 977, 226	1. 48	1. 45	−7	24, 938, 612	23, 946, 118	−4

[1] 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 1938, 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	475	488	1,227	1,935	2,231	2,245	2,013	2,273	1,919	2,170	1,738	1,192
New York and Maine	122	106	257	557	716	816	810	674	561	777	525	324
Ohio, western Pennsylvania, and West Virginia	261	175	460	667	865	959	1,132	1,246	1,119	1,197	799	536
Michigan	308	266	277	399	736	834	827	704	753	825	751	559
Wisconsin, Illinois, Indiana, and Kentucky	637	383	503	439	644	838	1,224	1,177	1,051	1,150	1,065	839
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	653	635	831	955	1,020	985	1,219	1,186	1,004	1,216	1,181	1,136
Eastern Missouri, Iowa, Minnesota, and South Dakota	362	171	373	625	1,009	1,030	1,114	1,179	1,142	1,182	1,097	734
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	567	400	449	535	824	671	518	571	811	836	745	687
Texas	334	444	664	751	717	611	630	390	624	536	648	605
Colorado, Montana, Utah, Wyoming, and Idaho	85	88	117	194	279	344	274	284	259	327	276	163
California	695	675	658	795	1,048	955	958	951	990	925	945	918
Oregon and Washington	35	85	63	131	272	247	249	372	326	415	414	373
United States, 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
1937	6,616	5,837	8,443	10,402	11,634	11,163	11,597	11,894	11,223	11,374	9,248	7,047
SHIPMENTS												
Eastern Pennsylvania, New Jersey, and Maryland	669	835	1,431	1,842	2,059	2,115	2,036	2,081	2,038	2,053	1,564	1,125
New York and Maine	152	174	355	490	654	732	724	711	713	674	475	330
Ohio, western Pennsylvania, and West Virginia	361	380	636	802	873	1,012	1,028	1,196	1,031	1,184	700	428
Michigan	177	196	408	586	650	812	650	902	958	983	636	347
Wisconsin, Illinois, Indiana, and Kentucky	257	297	606	796	845	1,091	1,149	1,497	1,416	1,531	805	470
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	648	717	901	935	1,058	1,099	991	1,223	1,194	1,273	1,027	956
Eastern Missouri, Iowa, Minnesota, and South Dakota	232	278	591	730	974	1,254	1,141	1,211	1,343	1,415	653	385
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	396	354	628	618	618	676	648	810	826	846	585	449
Texas	530	532	646	580	612	664	507	579	601	650	636	584
Colorado, Montana, Utah, Wyoming, and Idaho	94	125	193	246	270	300	258	294	305	304	181	134
California	801	604	746	891	974	1,024	839	1,075	965	1,001	887	773
Oregon and Washington	73	83	118	175	165	164	193	244	326	443	424	309
United States, 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
1937	4,689	5,163	7,879	10,272	11,890	12,645	12,237	12,291	12,773	11,190	8,188	4,793

STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	4,321	3,974	3,771	3,864	4,036	4,166	4,143	4,336	4,217	4,334	4,508	4,577
New York and Maine	1,617	1,550	1,451	1,519	1,581	1,665	1,751	1,713	1,561	1,664	1,715	1,710
Ohio, western Pennsylvania, and West Virginia	3,294	3,089	2,912	2,773	2,763	2,710	2,814	2,862	2,947	2,959	3,058	3,141
Michigan	2,265	2,334	2,203	2,015	2,102	2,124	2,302	2,104	1,899	1,736	1,850	2,078
Wisconsin, Illinois, Indiana, and Kentucky	3,275	3,361	3,258	2,900	2,699	2,446	2,536	2,215	1,850	1,469	1,730	2,098
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	1,812	1,730	1,660	1,680	1,642	1,530	1,758	1,721	1,532	1,476	1,630	1,810
Eastern Missouri, Iowa, Minnesota, and South Dakota	3,073	2,966	2,747	2,642	2,676	2,452	2,425	2,393	2,192	1,959	2,404	2,753
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	2,126	2,169	1,990	1,907	2,113	2,108	1,978	1,738	1,723	1,711	1,871	2,112
Texas	752	664	681	853	958	905	1,027	838	862	748	759	780
Colorado, Montana, Utah, Wyoming, and Idaho	616	578	503	451	460	503	519	510	463	487	581	612
California	1,365	1,436	1,348	1,253	1,327	1,257	1,376	1,319	1,343	1,268	1,325	1,470
Oregon and Washington	507	510	455	405	518	601	657	785	785	758	748	813
United States, 1938	25,023	24,361	22,979	22,262	22,875	22,467	23,286	22,534	21,374	20,569	22,179	23,954
1937	24,393	25,059	25,622	25,747	25,493	24,011	23,370	22,940	21,388	21,565	22,634	24,879

Summary of monthly estimates of clinker (unground portland cement) produced and in stock at mills in the United States in 1938, 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	517	498	1,202	1,825	2,194	2,157	2,015	2,328	1,803	2,094	1,732	1,285
New York and Maine	98	79	301	570	744	819	742	643	557	752	597	266
Ohio, western Pennsylvania, and West Virginia	292	237	526	630	931	973	1,108	1,169	1,117	1,157	785	470
Michigan	339	271	317	381	651	743	780	720	672	736	686	654
Wisconsin, Illinois, Indiana, and Kentucky	777	542	458	394	601	831	1,138	1,131	960	998	1,083	886
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	625	551	711	867	1,009	1,087	1,221	1,203	1,010	1,096	1,192	1,117
Eastern Missouri, Iowa, Minnesota, and South Dakota	408	270	375	702	971	1,029	1,136	1,122	1,079	1,098	1,091	712
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	552	410	364	573	832	680	490	508	773	806	768	675
Texas	263	415	643	775	747	491	743	419	498	502	613	692
Colorado, Montana, Utah, Wyoming, and Idaho	75	94	109	213	317	333	249	260	271	322	228	188
California	789	695	613	690	850	1,001	948	976	979	934	999	992
Oregon and Washington	27	(1)	68	201	217	217	270	431	408	422	429	426
United States, 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
1937	7,162	6,454	9,172	10,299	11,614	10,963	11,025	11,518	10,707	11,307	9,426	7,196
STOCKS (END OF MONTH)												
Eastern Pennsylvania, New Jersey, and Maryland	919	938	935	834	813	781	767	832	725	665	670	777
New York and Maine	266	239	285	303	340	351	271	246	249	233	311	259
Ohio, western Pennsylvania, and West Virginia	671	734	799	753	835	845	832	759	753	716	700	635
Michigan	467	475	529	521	453	385	346	378	317	244	185	267
Wisconsin, Illinois, Indiana, and Kentucky	628	787	743	687	641	634	549	493	402	242	242	285
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	698	615	498	440	459	539	546	554	565	451	466	450
Eastern Missouri, Iowa, Minnesota, and South Dakota	405	492	499	577	548	558	578	535	481	406	409	381
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	472	481	392	424	434	448	417	354	309	283	308	301
Texas	255	232	228	269	307	192	310	341	224	190	161	255
Colorado, Montana, Utah, Wyoming, and Idaho	109	116	107	128	168	159	135	111	124	120	74	116
California	1,310	1,319	1,298	1,174	1,000	1,022	1,012	908	879	885	923	984
Oregon and Washington	389	304	310	387	328	304	326	391	478	492	514	572
United States, 1938	6,589	6,732	6,623	6,497	6,326	6,218	6,089	5,902	5,506	4,927	4,963	5,282
1937	6,160	6,788	7,554	7,544	7,540	7,360	6,771	6,347	5,896	5,859	6,104	6,342

[1] Less than 1,000 barrels.

Producers' stocks of portland cement reported on hand at the mills were 4 percent lower at the end of 1938 than at the end of 1937. The following table gives stocks on December 31 and the seasonal fluctuations in stocks from 1934 to 1938.

Producers' stocks of finished portland cement and clinker (unground cement) on hand at mills in the United States on Dec. 31 and monthly range, 1934–38

		Dec. 31 (barrels)	Monthly range			
			Low		High	
			Month	Barrels	Month	Barrels
1934	Cement	21,440,594	January	19,547,000	July	21,852,000
	Clinker	6,166,000	do	5,919,000	do	6,588,000
1935	Cement	23,064,563	October	20,501,000	do	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	24,938,612	do	21,388,000	April	25,747,000
	Clinker	6,342,000	October	5,859,000	March	7,554,000
1938	Cement	23,946,118	do	20,569,000	January	25,023,000
	Clinker	5,282,000	do	4,927,000	February	6,732,000

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 1937 and 1938 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 affect certain States near the Canadian border and the seaboard.

Shipments of domestic portland cement from mills into States and per capita, 1937–38, in barrels [1]

State	1937 Total	1937 Per capita [1]	1938 Total	1938 Per capita [1]
Alabama	1,224,480	0.42	1,310,975	0.45
Arizona [2]	571,129	1.39	702,045	1.70
Arkansas	742,960	.36	779,153	.38
California	10,628,696	1.73	9,216,358	1.50
Colorado	1,056,286	.99	856,634	.80
Connecticut [2]	1,477,606	.85	1,365,048	.78
Delaware [2]	292,465	1.12	298,784	1.14
District of Columbia [2]	1,065,648	1.70	1,004,861	1.60
Florida	1,364,618	.82	1,236,370	.74
Georgia	1,422,525	.46	1,323,885	.43
Idaho	471,348	.96	382,709	.78
Illinois	6,945,077	.88	6,432,231	.82
Indiana	3,279,417	.94	2,837,462	.82
Iowa	3,248,502	1.27	3,226,718	1.26
Kansas	1,949,506	1.05	1,645,844	.88
Kentucky	1,704,498	.58	1,984,266	.68
Louisiana	1,695,022	.80	1,908,484	.90
Maine	392,568	.46	411,716	.48
Maryland	1,841,631	1.10	1,612,035	.96
Massachusetts [2]	2,065,685	.47	1,958,035	.44
Michigan	5,359,971	1.11	5,288,904	1.10
Minnesota	2,552,950	.96	2,394,117	.90
Mississippi [2]	1,815,516	.90	2,019,522	1.00
Missouri	3,131,558	.79	2,787,556	.70
Montana	820,101	1.52	391,573	.73
Nebraska	1,190,879	.87	1,102,230	.81
Nevada [2]	110,066	1.09	127,842	1.27
New Hampshire [2]	345,129	.68	289,235	.57
New Jersey	3,857,647	.89	3,423,585	.79
New Mexico [2]	825,183	1.96	891,119	2.11
New York	11,111,639	.86	10,823,514	.84
North Carolina [2]	1,432,289	.41	1,648,790	.47
North Dakota [2]	274,695	.39	279,648	.40
Ohio	5,419,879	.80	5,265,862	.78
Oklahoma	2,098,722	.82	1,900,253	.75
Oregon	762,281	.74	669,471	.65
Pennsylvania	7,212,509	.71	6,068,337	.60
Rhode Island [2]	422,468	.62	371,918	.55
South Carolina [2]	733,620	.39	768,781	.41
South Dakota	525,760	.76	393,566	.57
Tennessee	2,082,411	.72	1,969,645	.68
Texas	5,913,929	.96	6,271,197	1.02
Utah	499,813	.96	479,141	.92
Vermont [2]	295,460	.77	221,915	.58
Virginia	1,668,227	.62	2,307,481	.85
Washington	4,107,432	2.48	2,237,035	1.35
West Virginia	1,325,125	.71	1,021,349	.55
Wisconsin	3,000,657	1.03	2,620,103	.90
Wyoming	395,262	1.68	496,988	2.11
Unspecified	51,483		18,539	
	112,782,328	.87	105,042,829	.81
Exports reported by manufacturers but not included above [3]	1,022,454		1,281,298	
Total shipped from cement plants	113,804,782		106,324,127	

[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, Hawaii, and Puerto Rico.

The following table of monthly shipments from portland-cement mills into States in 1938 is based on monthly reports of producers. Although the totals may vary slightly from figures shown in tables based on annual reports they reflect the seasonal fluctuations with fair accuracy.

Portland cement shipped from mills into States in 1938, by months, in barrels

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Alabama	101,086	98,813	99,317	76,502	122,089	128,362	114,216	124,246	112,298	124,001	109,344	100,523
Alaska	139	812					150	125	263			
Arizona	58,297	64,882	39,120	53,323	64,281	70,954	45,703	68,500	50,107	65,342	61,878	62,081
Arkansas	30,448	28,249	47,705	66,980	56,511	57,739	54,258	65,736	100,653	92,096	96,424	79,758
California	692,734	496,117	644,724	790,235	858,852	895,874	743,945	945,510	845,456	894,624	773,009	677,103
Colorado	39,016	39,361	60,866	79,537	88,096	87,326	77,323	82,565	86,447	99,604	65,963	50,406
Connecticut	29,518	40,340	74,713	136,235	170,157	138,833	139,708	133,037	141,235	170,773	116,164	73,076
Delaware	7,412	10,652	20,639	17,658	22,825	27,056	37,862	44,648	38,805	33,576	21,298	11,404
District of Columbia	42,947	46,470	65,321	84,342	89,551	121,639	91,683	121,962	98,728	101,855	77,291	60,898
Florida	93,983	95,790	82,649	101,901	91,950	96,167	100,792	110,486	98,616	124,182	115,157	132,511
Georgia	91,283	100,196	131,910	121,172	113,557	96,276	97,446	134,986	135,181	118,967	98,034	84,635
Hawaii	37,720	26,969	36,215	19,322	20,692	27,137	20,250	23,285	17,768	20,612	30,045	23,371
Idaho	9,770	17,347	28,029	37,756	41,355	41,784	33,640	39,820	41,435	42,870	28,590	20,705
Illinois	135,402	172,662	407,554	422,934	480,206	588,835	675,301	838,281	839,549	1,023,274	536,772	311,095
Indiana	66,651	86,221	174,574	197,245	236,397	272,709	296,656	452,264	385,724	357,162	196,656	120,043
Iowa	32,666	58,354	128,960	175,454	289,843	423,793	428,888	513,725	476,711	494,623	138,190	64,031
Kansas	85,500	79,541	153,824	147,779	140,019	154,500	125,906	148,242	195,759	183,878	122,090	108,557
Kentucky	61,614	54,930	108,474	189,013	190,784	216,946	195,268	218,472	232,792	269,710	159,067	87,963
Louisiana	136,985	149,821	173,795	139,081	154,345	197,070	162,353	146,861	185,504	169,808	139,570	153,821
Maine	7,995	5,905	9,689	25,035	41,133	57,860	60,699	53,111	53,105	56,130	23,577	17,382
Maryland	52,255	76,399	109,952	156,723	152,549	150,239	154,332	179,425	149,826	198,013	136,358	95,124
Massachusetts	50,512	62,890	125,681	162,261	189,515	183,418	216,956	180,898	272,023	189,449	177,295	147,174
Michigan	140,241	152,343	282,273	479,871	484,329	630,238	493,054	679,045	693,636	645,942	434,632	213,611
Minnesota	42,394	74,978	154,968	165,973	224,834	317,927	253,271	261,335	361,678	330,926	122,179	83,254
Mississippi	70,030	100,968	157,807	165,891	218,261	186,906	188,397	220,197	231,012	239,786	151,159	94,683
Missouri	95,441	91,661	192,494	222,651	214,512	306,263	270,340	307,296	304,307	346,887	271,908	163,374
Montana	18,317	19,250	26,220	38,631	33,658	39,071	40,759	44,357	46,476	43,319	21,843	19,604
Nebraska	33,354	33,212	78,259	69,109	71,184	108,873	112,123	138,722	174,441	170,028	72,785	39,968
Nevada	6,294	5,228	8,263	14,111	13,877	13,919	9,936	12,582	10,917	12,033	10,206	8,968
New Hampshire	6,173	7,221	15,635	31,893	29,254	37,112	45,410	21,150	33,628	24,385	23,570	13,731
New Jersey	122,198	142,307	257,368	308,909	355,526	364,826	362,901	369,706	370,559	341,775	259,037	169,072
New Mexico	57,872	65,787	80,390	100,529	82,495	98,062	73,889	64,371	52,404	77,285	91,279	65,908
New York	357,211	398,397	720,967	928,573	1,113,991	1,238,272	1,211,944	1,189,801	1,127,421	1,110,777	818,291	587,254
North Carolina	68,633	87,510	152,190	151,529	165,294	134,852	129,700	163,822	164,672	152,642	163,800	114,535
North Dakota	4,545	2,922	20,337	31,599	32,467	46,333	32,219	28,899	29,320	36,440	9,668	4,844
Ohio	168,225	173,929	338,151	441,436	466,437	539,073	526,860	618,494	577,149	724,919	435,666	262,499
Oklahoma	138,781	95,970	162,812	156,193	172,549	150,479	145,037	223,229	178,551	170,026	155,720	148,039
Oregon	29,198	33,496	46,400	58,432	56,414	63,027	61,096	91,322	85,714	62,910	42,456	39,028
Pennsylvania	223,463	260,908	420,782	550,107	650,216	699,241	643,658	696,319	576,714	643,128	428,107	272,822
Puerto Rico	12,841	40,835	36,839	45,270	49,514	34,732	25,219	35,985	34,459	19,460	32,392	31,960
Rhode Island	6,494	10,891	26,975	37,381	37,697	49,024	48,655	35,548	54,221	26,460	29,518	22,600
South Carolina	51,800	62,542	60,650	55,755	72,750	85,984	56,704	70,363	62,437	70,376	64,116	60,079
South Dakota	8,196	13,195	33,155	33,497	32,925	47,428	39,368	39,979	44,309	62,762	23,785	14,904
Tennessee	77,260	71,927	103,584	129,204	160,978	223,894	183,442	198,026	180,382	271,376	176,268	180,447
Texas	480,162	469,792	574,458	522,614	548,206	563,712	428,557	505,923	538,972	576,851	552,228	508,444
Utah	10,806	15,423	25,482	44,953	47,916	53,946	39,565	49,562	61,081	62,030	40,400	27,915

Portland cement shipped from mills into States in 1938, by months, in barrels—Continued

Shipped to—	January	February	March	April	May	June	July	August	September	October	November	December
Vermont	2,489	3,021	7,937	21,235	32,972	28,744	25,462	25,215	25,579	29,047	18,979	8,671
Virginia	99,963	112,444	163,572	211,858	201,986	221,805	217,584	284,906	230,916	239,894	181,242	133,757
Washington	56,227	57,707	89,912	130,121	127,085	125,631	153,388	176,556	273,508	388,208	387,924	270,317
West Virginia	41,153	45,384	66,116	77,365	76,375	93,662	92,360	122,164	112,488	114,842	80,352	54,228
Wisconsin	46,046	51,189	116,145	173,334	250,097	285,544	271,303	392,886	391,910	377,432	171,822	91,971
Wyoming	8,580	26,403	40,795	47,135	52,934	60,625	57,250	64,889	66,368	48,508	13,049	10,435
Unspecified	21,759	1,026	18,348	13,000	11,016	28,144	1,000	27,251	18,466	23,207	14,795	16,643
	4,370,079	4,540,587	7,202,995	8,658,647	9,702,456	10,911,866	10,113,786	11,786,085	11,671,680	12,274,210	8,521,948	6,215,226
Foreign countries	19,921	34,413	56,005	32,353	49,544	31,134	50,214	36,915	44,320	82,790	51,052	74,774
Total shipped from cement plants	4,390,000	4,575,000	7,259,000	8,691,000	9,752,000	10,943,000	10,164,000	11,823,000	11,716,000	12,357,000	8,573,000	6,290,000

The Bureau of Mines has no facilities for collecting statistics on the consumption of portland cement by uses. The following estimates were made by engineers of the Portland Cement Association, who are in touch with various industries throughout the country that use cement.

Estimated distribution of portland cement in the United States in 1937, by uses[1]

Classification	Percent	Barrels
Paving: Roads, streets, and airports	23	25,940,000
Structural: Buildings, bridges, and railroads	32	36,090,000
Conservation: Reclamation, water supply, and sewerage	19	21,430,000
Housing and miscellaneous uses	17	18,040,000
Farm	9	11,280,000
	100	112,780,000

[1] Compiled by the Portland Cement Association; based on analyses of construction figures and other data.

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 is also indicated in the table showing consumption per capita.

The surplus in the following table was distributed by years as follows: In 1937, to non-cement-producing States 11,726,959 barrels, foreign countries and Alaska, Hawaii, and Puerto Rico 1,022,454 barrels, and unspecified 51,483 barrels; in 1938, to non-cement-producing States 11,947,543 barrels, foreign countries and Alaska, Hawaii, and Puerto Rico 1,281,298 barrels, and unspecified, 18,539 barrels.

Estimated surplus or deficiency in local supply of portland cement in cement-producing States, 1937–38, in barrels

State or division	1937			1938		
	Shipments from mills	Estimated consumption	Surplus or deficiency	Shipments from mills	Estimated consumption	Surplus or deficiency
Alabama	4,403,459	1,224,480	+3,178,979	4,548,079	1,310,975	+3,237,104
California	11,877,642	10,628,696	+1,248,946	10,539,010	9,216,358	+1,322,652
Illinois	4,713,734	6,945,077	−2,231,343	4,357,119	6,432,231	−2,075,112
Iowa	4,598,453	3,248,502	+1,349,951	4,759,390	3,226,718	+1,532,672
Kansas	3,500,684	1,949,506	+1,551,178	3,217,497	1,645,844	+1,571,653
Michigan	7,831,880	5,359,971	+2,471,909	7,192,511	5,288,904	+1,903,607
Missouri	4,565,448	3,131,558	+1,433,890	4,570,389	2,787,556	+1,782,833
Ohio	5,501,769	5,419,879	+81,890	5,258,603	5,265,862	−7,259
Pennsylvania	22,952,603	7,212,509	+15,740,094	21,082,966	6,068,337	+15,014,629
Tennessee	3,013,817	2,082,411	+931,406	3,390,871	1,969,645	+1,421,226
Texas	6,687,719	5,913,929	+773,790	7,116,545	6,271,197	+845,348
Colorado, Montana, Utah, Wyoming, and Idaho	3,000,825	3,242,810	−241,985	2,705,161	2,607,045	+98,116
Oregon and Washington	4,644,984	4,869,713	−224,729	2,716,270	2,906,506	−190,236
Georgia, Kentucky, Virginia, Florida, and Louisiana	4,398,485	7,854,890	−3,456,405	4,954,431	8,760,486	−3,806,055
Indiana, Wisconsin, Minnesota, Nebraska, Oklahoma, South Dakota, and Arkansas	12,250,785	13,391,345	−1,140,560	10,615,153	12,026,884	−1,411,731
Maryland, New Jersey, and West Virginia	3,334,233	7,024,403	−3,690,170	3,115,611	6,056,969	−2,941,358
New York and Maine	6,528,262	11,504,207	−4,975,945	6,184,521	11,235,230	−5,050,709
	113,804,782	101,003,886	+12,800,896	106,324,127	93,076,747	+13,247,880

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 in the table of shipments by States and districts during 1937 and 1938, on a preceding page. 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 1938 was $3.66; in 1937, $3.77. The average factory selling price of high-early-strength portland cement was $1.85 per barrel in 1938 and $1.86 per barrel in 1937. 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 1934 through 1938.

Average factory value per barrel in bulk of portland cement in the United States, 1934–38

1934	$1.54	1937	$1.48
1935	1.51	1938	1.45
1936	1.51		

CAPACITY

At the end of 1938, the capacity for producing finished portland cement of the 151 plants active and shipping in 1938 and the 11 plants inactive in 1938 but producing or shipping from stock on hand within the 7 previous years is shown in the following table with similar figures for 1937. Figures for plant capacity are based on manufacturers' reports, supplemented by a few estimates.

Portland-cement manufacturing capacity of the United States, 1937–38, by commercial districts

District	Estimated capacity (barrels)		Percent of capacity utilized	
	1937	1938	1937	1938
Eastern Pennsylvania, New Jersey, and Maryland	50,712,000	50,712,000	41.8	39.2
New York and Maine	17,199,000	17,124,000	37.0	36.5
Ohio, western Pennsylvania, and West Virginia	28,677,000	28,447,000	37.6	33.0
Michigan	16,605,000	16,605,000	49.3	43.1
Wisconsin, Illinois, Indiana, and Kentucky	29,046,000	29,046,000	43.9	34.2
Virginia, Tennessee, Alabama, Georgia, Florida, and Louisiana	25,855,000	25,755,000	42.6	46.7
Eastern Missouri, Iowa, Minnesota, and South Dakota	23,017,000	22,917,000	46.4	43.6
Western Missouri, Nebraska, Kansas, Oklahoma, and Arkansas	17,159,000	17,159,000	50.4	44.3
Texas	11,742,000	12,042,000	58.8	57.7
Colorado, Montana, Utah, Wyoming, and Idaho	6,125,000	6,125,000	49.9	43.9
California	22,241,000	22,820,000	53.7	46.1
Oregon and Washington	6,845,000	6,945,000	67.6	42.9
	255,223,000	255,697,000	45.5	41.2

The following estimates, based on the monthly reports of producers, of the relation between the production of finished portland cement and the manufacturing capacity of the industry for each month in1937 and 1938 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, 1937–38

Month	Monthly 1937	Monthly 1938	12 months ended— 1937	12 months ended— 1938	Month	Monthly 1937	Monthly 1938	12 months ended— 1937	12 months ended— 1938
January	30.4	20.7	44.9	44.5	July	53.1	50.2	47.8	40.8
February	29.6	19.8	45.8	43.7	August	54.4	50.4	47.6	40.4
March	38.6	26.9	47.0	42.7	September	53.1	49.9	47.1	40.2
April	48.8	37.7	47.6	41.8	October	52.0	52.9	46.7	40.2
May	53.2	47.4	47.9	41.3	November	43.7	48.2	46.0	40.6
June	52.8	49.8	47.8	41.0	December	32.2	36.9	45.3	41.0

The following table gives statistics of capacity, 1936–38, 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, 1936–38, by processes

Process	Estimated capacity: Thousands of barrels 1936	1937	1938	Estimated capacity: Percent of total 1936	1937	1938	Percent of capacity utilized 1936	1937	1938	Percent of total finished cement produced 1936	1937	1938
Wet	122,727	122,638	119,776	48.0	48.1	46.8	46.3	49.2	46.1	50.5	51.9	52.4
Dry	132,777	132,585	135,921	52.0	51.9	53.2	42.0	42.1	36.9	49.5	48.1	47.6
	255,504	255,223	255,697	100.0	100.0	100.0	44.1	45.5	41.2	100.0	100.0	100.0

RAW MATERIALS

In 1938 producers reported that approximately 32,234,000 short tons 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: 26,183,000 tons 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 (including glass and silica 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 674,062 short tons of gypsum and anhydrite were used as cement retarder in 1938. This represented 19 percent of the total crude-gypsum supply (domestic and imported) of the country.

[1] Details in the chapter on Gypsum in this volume.

MANUFACTURING CONDITIONS AND NEW DEVELOPMENTS

Plants.—In 1938 portland cement was manufactured at 149 plants, and shipments were made from 151 plants compared with 149 plants producing and 150 plants shipping in 1937. The new plant of the Gulf Portland Cement Co. at Houston, Tex., began production early in 1938. The new wet-process plant of the Puerto Rico Cement Corporation near San Juan, Puerto Rico, was virtually completed in May 1938, but operation was not reported until January 1939.

Large modernization programs affecting many plants have been reported. A device known as the "electric ear" for controlling the feed of grinding mills has been installed at the Medusa Portland Cement Co. plants at Toledo, Ohio, and York, Pa., and at the Hagerstown (Md.) plant of the North American Cement Corporation. This and many other new developments involving changes from wet to dry process, introduction of Diesel-driven automotive haulage, use of dust-precipitating equipment, and improvements in grinding and calcining have been described in some detail in the technical press.[2]

The use of iron oxide in the cement raw mix is increasing. Single mills in Pennsylvania are using as much as 2,000 tons a year. They employ the lowest-priced material available—roll scale, pyrite cinder, or impure iron ore.

Specifications.[3]—The Federal Specifications Executive Committee has been active in issuing specifications on cement. The following have been promulgated: Portland cement, SS–C–191A; high-early-strength, SS–C–201; moderate-heat, SS–C–206; sulfate-resisting, SS–C–211; cements, hydraulic, general specifications (methods for sampling, inspection, and testing), SS–C–158; cement, portland, pozzolana, SS–C–208; and cement, masonry, SS–C–181B. The American Society for Testing Materials has issued a revised tentative specification for masonry cement (C91–T).

The measurement of fineness by surface area of the particles rather than by screen test is now regarded as standard procedure. The Federal specifications mentioned in the preceding paragraph designate the fineness requirement in square centimeters per gram as determined by a Wagner turbidimeter.

Flotation methods.—For several years froth flotation has been used successfully at Valley Forge, Pa., for the purification of cement raw materials. A second plant using the process is situated in the Union of South Africa, and recently a third plant has been established at Parma, Argentina. Research on flotation of limestone is now being conducted in the Lehigh Valley cement district of Pennsylvania.

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 in 1938 compared with the production of 104,117,000 barrels of clinker (unground cement) and 105,357,000 barrels of finished cement: Coal, 4,482,663 short tons; oil, 1,927,584 barrels (42 gallons); and natural gas, 37,336,231,988 cubic feet. Corresponding figures for 1937 are:

[2] *See* Pit and Quarry, vol. 31, January 1939, pp. 84–90; Rock Products, vol. 42, February 1939, pp. 31–36, and vol. 42, March 1939, pp. 26–31; Chem. and Met. Eng., vol. 46, March 1939, p. 170.

[3] Copies of Federal specifications may be obtained upon application accompanied by money order, coupon, or cash to the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 5 cents each. American Society for Testing Materials specifications may be obtained from the office of the secretary of the society, 260 South Broad St., Philadelphia, Pa.

Clinker produced, 116,843,000 barrels; and finished cement produced, 116,174,708 barrels. Fuels consumed were: Coal, 5,246,537 short tons; oil, 2,398,130 barrels; and natural gas, 40,449,920,245 cubic feet.

Electric power.—The accompanying table gives the electric energy produced at portland-cement plants and that purchased from power companies during 1937 and 1938. The table shows that the industry generated 51 percent of the electric power used at manufacturing plants in 1938.

Electrical energy used at portland-cement producing plants, 1937–38, by processes, in kilowatt-hours

Process	Electrical energy used						Finished cement produced	Average electrical energy used per barrel of cement produced
	Generated at portland-cement plants		Purchased		Total			
	Active plants	Kilowatt-hours	Active plants	Kilowatt-hours	Kilowatt-hours	Percent	Barrels	Kilowatt-hours
1937								
Wet	34	590, 184, 860	71	784, 662, 991	1, 374, 847, 851	51. 2	60, 334, 050	22. 8
Dry	37	834, 243, 065	51	477, 552, 518	1, 311, 795, 583	48. 8	55, 840, 658	23. 5
	71	1, 424, 427, 925	122	1, 262, 215, 509	2, 686, 643, 434	100. 0	116, 174, 708	23. 1
Percent of total electrical energy used		53. 0		47. 0	100. 0			
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			

SPECIAL PORTLAND CEMENTS

Regular or standard portland cements have been greatly improved during recent years. They attain adequate strength for ordinary use in a much shorter time and have higher ultimate strength and better workability than cements made some years ago. Although these cements 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 cement, the raw materials of which are unusually pure and which has a very 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 a 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, which evidently are specially prepared from portland-cement clinker and other ingredients. Production of such cements, made at 32 plants in 1938, totaled 1,246,263 barrels and shipments 1,225,960 barrels valued at $1,589,908, an average of $1.30 a barrel. Corresponding data for 1937, representing the output of 20 plants, are: Production 747,678 barrels and shipments 694,389 barrels valued at $970,446, an average of $1.40 a barrel. To avoid duplication the above figures are not included in the portland-cement totals, because portland-cement clinker is evidently 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 recorded earlier in this chapter.

Portland-puzzolan cement.—Portland-puzzolan cements, including those reported as "high-silica," are specially adapted for resistance to chemical attack such as the reaction with salts contained in sea water. They are made by adding 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, 1936–38, by kinds

Kind and year	Active plants	Production (barrels)	Shipments		
			Barrels	Value	
				Total	Average
High-early-strength:					
1936	52	2,982,748	3,080,849	$5,904,399	$1.92
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
Masonry or mortar:					
1936 [1]	15	430,785	404,672	518,482	1.28
1937	10	257,385	273,144	362,807	1.33
1938	5	84,875	88,905	124,239	1.40
Low and moderate heat:					
1936	28	3,660,380	3,600,776	4,896,786	1.36
1937	29	3,169,593	3,511,674	5,008,217	1.43
1938	40	4,132,237	3,730,814	5,550,369	1.49
Portland-puzzolan:					
1936	8	548,207	540,788	561,942	1.04
1937	6	260,194	294,384	417,130	1.42
1938	6	159,745	149,142	229,441	1.54
Oil well:					
1936	8	250,688	237,709	508,848	2.14
1937	9	342,316	313,064	652,960	2.09
1938	7	226,769	220,122	457,665	2.08
Miscellaneous:					
1936	18	1,232,117	1,215,938	1,747,802	1.44
1937	13	580,705	587,718	928,856	1.58
1938	16	608,777	589,663	965,970	1.64

[1] Figures for 1936 not exactly comparable with succeeding years, as they include some masonry cement other than portland for which separate statistics were not compiled prior to 1937.

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 a previous page.

In addition to portland-puzzolan cements discussed on a 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. The Birmingham industry has been described by Cudworth and Mead.[4]

Figures for production and shipments of special types of cement other than portland are presented in the following table.

[4] Cudworth, James R., and Mead, Joseph C., Utilization of Slag in the Birmingham District. Alabama: Am. Inst. Min. and Met. Eng. Tech. Pub. 796, 1937, 9 pp.

Natural, masonry (natural), and puzzolan (slag-lime) cements produced, shipped, and in stock at mills in the United States, 1934–38

Year	Production		Shipments		Stock (Dec. 31)
	Active plants	Barrels (376 pounds)	Barrels (376 pounds)	Value	Barrels (376 pounds)
1934	14	671,588	678,204	$960,732	175,865
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	258,031
1938	11	1,704,662	1,745,541	2,558,077	196,649

FOREIGN TRADE [5]

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. Values ranged in 1938 from $0.93 per barrel for imports from Yugoslavia to $2.02 per barrel for imports from the United Kingdom.

Hydraulic cement imported for consumption in the United States, 1934–38

Year	Barrels	Value	Year	Barrels	Value
1934	265,997	$264,416	1937	1,803,932	$1,392,633
1935	619,404	615,866	1938	1,727,411	1,436,730
1936	1,658,902	1,421,620			

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: 1938, 12,227 barrels valued at $38,557, of which 5,439 barrels valued at $17,466 came from Belgium, 3,262 barrels valued at $6,394 from France, and 1,555 barrels valued at $5,892 from the United Kingdom; 1937, 12,808 barrels valued at $39,875, of which 4,214 barrels valued at $13,775 came from Belgium, 3,728 barrels valued at $13,691 from the United Kingdom, and 2,711 barrels valued at $6,000 from France.

[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.

Roman, portland, and other hydraulic cements imported for consumption in the United States, 1937–38, by countries and districts

	1937		1938	
	Barrels	Value	Barrels	Value
COUNTRY				
Belgium	1,004,290	$689,830	1,168,148	$852,233
Canada	14,536	14,379	1,385	3,372
Denmark	292,054	277,848	279,317	281,551
France	378	931	5,053	4,465
Germany	159,210	112,869	78,365	92,268
Italy			645	2,769
Japan	126,484	106,442	71,574	61,351
Mexico	427	1,008	149	312
Netherlands	131,507	86,620	33,872	26,169
Norway	45,249	34,492	21,238	17,072
Poland and Danzig			30,062	23,121
United Kingdom	6,782	22,048	9,189	18,526
Yugoslavia	10,207	6,291	16,187	14,964
	1,791,124	1,352,758	1,715,184	1,398,173
DISTRICT				
Connecticut	10,309	10,373	5,146	6,922
El Paso	134	284	149	312
Florida	298,520	238,162	344,238	281,414
Galveston	910	648	14,702	10,070
Georgia	18,708	13,605	44,131	31,060
Hawaii	126,084	106,014	71,573	61,351
Los Angeles	400	428	50	36
Maine and New Hampshire	630	1,845	1,383	3,368
Maryland	55,207	40,278	67,363	45,310
Massachusetts	178,599	135,198	115,449	103,660
Mobile	61,955	42,955	43,549	31,499
New Orleans	3,120	2,635	8,020	6,565
New York	450,914	338,462	469,217	414,081
North Carolina	6,170	4,400	1,313	891
Oregon	22,469	17,487	9,750	6,811
Philadelphia	57,538	37,091	93,694	58,005
Puerto Rico	384,821	279,019	263,777	213,063
Rhode Island	25,160	12,222	13,939	9,047
Sabine	2,097	1,642	3,200	2,549
St. Lawrence	13	63		
San Antonio	32,149	24,239	49,452	40,532
San Diego			1,787	1,234
San Francisco	412	2,663	1,993	1,268
South Carolina	17,243	13,056	53,406	38,455
Vermont			2	4
Virgin Islands	10,454	8,862	9,519	9,294
Washington	27,108	21,127	28,382	21,372
	1,791,124	1,352,758	1,715,184	1,398,173

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 have amounted to less than 1 percent of total domestic shipments during recent years. 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, 1934–38

Year	Barrels	Value	Percent of total shipments from mills
1934	566,171	$1,133,381	0.7
1935	416,099	1,012,942	.6
1936	334,673	886,560	.3
1937	378,554	1,044,161	.3
1938	558,226	1,294,883	.5

The following table shows exports by country of destination in 1937 and 1938.

Hydraulic cement exported from the United States, 1937–38, by countries

Country	1937		1938	
	Barrels	Value	Barrels	Value
North America:				
Bermuda	645	$1,577	1,334	$2,316
Canada	10,419	50,237	9,147	41,052
Central America:				
British Honduras	4,212	6,436	4,228	6,088
Costa Rica	350	1,696	1,309	2,886
Guatemala	5,028	7,194	142	257
Honduras	9,031	13,956	7,100	10,627
Nicaragua	3,318	6,269	1,837	3,154
Panama	85,693	177,751	94,247	196,326
Salvador	310	1,119	300	1,312
Mexico	21,658	62,761	23,438	68,350
Newfoundland and Labrador	1,580	7,112	676	1,506
West Indies:				
British:				
Jamaica	94	459	260	752
Trinidad and Tobago	1,151	3,490	710	2,466
Other British	1,576	4,339	1,220	3,357
Cuba	16,988	76,441	12,309	52,407
Dominican Republic	2,300	5,928	2,128	6,609
French			10	11
Haiti	729	1,892	3,027	4,415
Netherland	3,056	8,396	10,428	26,082
	168,138	437,053	173,850	429,973
South America:				
Argentina	29,027	125,912	35,181	149,505
Bolivia	1,180	3,086	175	881
Brazil	16,342	68,464	11,843	47,333
Chile	4,200	21,027	5,413	27,222
Colombia	11,898	32,951	20,635	55,817
Ecuador	1,776	6,994	503	2,172
Guiana: French	165	355		
Paraguay	10	32	75	368
Peru	2,512	11,553	3,675	16,667
Uruguay	4,999	20,914	1,887	7,048
Venezuela	115,829	209,582	216,943	377,301
Other South America			500	830
	187,938	500,870	296,830	685,144
Europe:				
Belgium	1,395	6,103	874	3,899
Ireland	270	1,221	284	1,479
Netherlands	375	1,971	458	2,279
United Kingdom	9,251	38,558	5,964	24,007
Other Europe	502	2,559	194	1,340
	11,793	50,412	7,774	33,004
Asia:				
British Malaya	465	1,942	315	1,193
China	9	29	7	70
India, British	1,280	6,891	1,275	6,498
Palestine	132	622	132	622
Philippine Islands	942	4,905	70,327	104,538
Saudi Arabia	500	2,299	1,932	7,207
Other Asia	2,768	15,238	3,317	14,429
	6,096	31,926	77,305	134,557

Hydraulic cement exported from the United States, 1937–38, by countries—Continued

Country	1937		1938	
	Barrels	Value	Barrels	Value
Africa:				
Egypt	300	$1,425	140	$913
Portuguese	30	166	48	197
Union of South Africa	1,314	6,359	1,455	7,383
Other Africa			35	166
	1,644	7,950	1,678	8,659
Oceania:				
British:				
Australia	1,981	12,807	499	2,178
New Zealand	312	1,152	285	1,351
Other	1	5	5	17
French	651	1,986		
	2,945	15,950	789	3,546
	378,554	1,044,161	558,226	1,294,883

The following table shows shipments of cement to outlying Territories of the United States in 1937 and 1938.

Domestic hydraulic cement shipped to noncontiguous Territories of the United States, 1937–38

	1937		1938	
	Barrels	Value	Barrels	Value
Alaska	27,847	$75,727	40,982	$112,692
American Samoa	10	25	3	6
Guam			2	14
Hawaii	229,336	504,596	321,578	710,573
Midway Island [1]	13	44	28	88
Puerto Rico	357,562	519,293	418,521	574,033
Virgin Islands	15,525	28,306	14,017	27,905
Wake Island	43	148	10	43
	630,336	1,128,139	795,141	1,425,354

[1] Beginning July 1, 1937.

WORLD PRODUCTION

The following table of world production was compiled for the first time by the Bureau of Mines from consular reports, official statistics, and trade literature. The figures are in metric tons (1 metric ton equals 2,204.6 pounds). The table shows production from 1934 to 1938, inclusive, and the latest reported plant capacity. Although figures for certain countries are still lacking the table presents the most complete picture of the cement industry throughout the world that has yet appeared. Figures on capacity are the best estimates that can be made from available data and are subject to revision.

World production of cement, 1934–38, and latest reported capacity, by countries, in metric tons [1]

[Compiled by R. B. Miller]

Country	Latest reported capacity [2]	Production				
		1934	1935	1936	1937	1938
North America:						
Canada	2,390,000	553,145	553,679	784,103	975,231	882,376
Cuba	(3)	(3)	(3)	(3)	(3)	(4)
Mexico	(3)	(3)	251,651	285,978	344,693	(4)
United States	43,609,082	13,374,408	13,259,847	19,522,716	20,137,732	18,259,349
South America:						
Argentina	1,045,000	567,000	721,564	833,631	1,010,000	(4)
Bolivia	(3)	26,815	40,212	61,841	(3)	(4)
Brazil	830,000	323,911	362,999	483,023	571,452	[5] 650,000
Chile	425,000	203,416	284,885	248,424	313,110	363,987
Colombia	(3)	71,018	77,000	104,465	123,175	(4)
Ecuador	20,000	(3)	13,674	(3)	(3)	(4)
Peru	120,000	45,576	60,296	75,115	83,048	101,707
Uruguay	200,000	106,213	99,778	111,073	147,773	(4)
Venezuela	50,000	(3)	(3)	(3)	(3)	(4)
Europe:						
Albania	(3)	(3)	(3)	8,000	14,000	(4)
Belgium	4,000,000	1,900,000	2,200,000	2,350,000	(3)	(4)
Bulgaria	240,000	114,000	105,000	113,000	135,000	(4)
Czechoslovakia	2,300,000	900,000	958,000	1,050,000	1,360,000	(4)
Denmark	938,000	769,563	756,823	792,369	676,125	(4)
Esthonia	(3)	31,723	37,990	50,611	65,931	79,740
Finland	640,000	228,062	269,315	332,557	410,371	(4)
France	10,012,000	4,872,100	4,403,800	4,638,400	(3)	(4)
Germany	17,000,000	6,470,000	8,807,000	11,689,000	12,605,000	(4)
Austria	900,000	310,000	370,000	380,000	426,000	(4)
Greece	280,000	248,000	273,000	276,850	(3)	(4)
Hungary	876,000	225,000	280,000	215,000	(3)	(4)
Italy	6,000,000	4,076,105	4,223,118	3,826,548	4,359,112	(4)
Latvia	170,000	69,553	72,013	100,213	122,426	(4)
Netherlands	470,000	394,000	360,000	401,000	441,000	(4)
Norway	358,000	249,453	263,127	300,658	320,481	(4)
Poland	1,850,000	720,788	842,604	1,048,270	1,289,108	1,719,452
Portugal	260,000	185,146	214,000	245,343	254,000	(4)
Rumania	1,200,000	314,350	361,000	376,000	456,311	(4)
Spain	2,600,000	1,362,000	[5] 1,355,000	(3)	(3)	(4)
Sweden	(3)	583,196	739,630	795,181	875,541	(4)
Switzerland	1,200,000	(3)	(3)	509,000	(3)	(4)
U. S. S. R.	6,000,000	3,532,808	4,488,600	5,849,700	5,873,000	(4)
United Kingdom	10,000,000	5,280,000	5,900,000	6,700,000	7,300,000	(4)
Yugoslavia	1,680,000	670,000	785,000	643,072	618,635	(4)
Asia:						
China	1,170,000	(3)	(3)	[5] 450,000	(3)	(4)
Manchuria	1,010,000	232,600	378,000	580,000	[5] 800,000	(4)
Chosen	1,600,000	222,000	460,000	567,000	665,000	(4)
India, British	1,465,000	767,000	892,000	977,000	1,142,000	(4)
Indochina	250,000	115,000	107,000	149,230	234,638	(4)
Iran	125,000	(3)	(3)	(3)	(3)	(4)
Japan	13,100,000	4,664,570	5,876,803	6,232,206	6,703,328	(4)
Levant	(3)	----------	100,000	136,000	175,700	(4)
Netherland India	235,000	113,000	140,000	136,000	(3)	(4)
Palestine	(3)	143,000	187,000	165,000	158,000	(4)
Philippine Islands	(3)	95,685	110,825	132,910	148,000	(4)
Siam	120,000	51,000	49,000	62,000	77,000	(4)
Syria	(3)	20,000	33,450	58,000	74,000	65,516
Turkey	350,000	168,500	131,175	177,506	214,794	(4)
Africa:						
Algeria	(3)	96,240	64,700	66,800	67,000	(4)
Belgian Congo	40,000	10,000	7,632	11,420	18,000	(4)
Egypt	700,000	296,837	378,780	335,000	330,000	(4)
Madagascar	70,000	13,000	4,000	----------	----------	(4)
Morocco, French	(3)	185,000	189,000	161,780	156,000	(4)
Mozambique	30,000	11,531	12,572	11,826	14,957	24,483
Tunisia	(3)	34,300	39,700	48,600	56,400	(4)
Union of South Africa	1,000,000	436,000	527,000	760,047	839,526	(4)
Oceania: Australia	1,323,000	417,000	559,000	656,000	[5] 730,000	(4)
	144,020,000	58,250,000	65,370,000	78,460,000	[5] 83,040,000	(4)

[1] Table includes all kinds of cement. Few data are available for Afghanistan, Burma, Eritrea, Ethiopia, Hong Kong, Luxemburg, Taiwan, and Venezuela, 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 Spain 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] Approximate production.

Canada.—According to the Dominion Bureau of Statistics, sales of portland cement by Canadian producers declined 11 percent in quantity and 9 percent in value in 1938 compared with 1937. The Canadian Cement Co., Ltd., the largest producer, operated two plants in Quebec, two in Ontario, and one each in Manitoba and Alberta. Two smaller companies also produce cement in Canada, one in Ontario and the other in British Columbia. The following table presents the principal statistics of the Canadian industry.

Salient statistics of the cement industry in Canada, 1937–38 [1]

	1937		1938	
	Barrels	Value	Barrels	Value
Output	6, 142, 934		5, 558, 047	
Sales:				
Quebec	2, 578, 623	$3, 537, 798	2, 730, 320	$3, 693, 188
Ontario	2, 650, 652	3, 657, 067	1, 818, 032	2, 555, 214
Manitoba	328, 518	745, 736	330, 889	754, 427
Alberta	267, 106	531, 541	304, 373	611, 790
British Columbia	344, 072	623, 725	335, 488	626, 731
Total sales	6, 168, 971	9, 095, 867	5, 519, 102	8, 241, 350
Stocks, Dec. 31	1, 806, 343		1, 875, 288	
Imports:				
Portland	61, 082	134, 113	48, 497	105, 326
Manufactures		45, 744		6, 650
Total imports		179, 857		111, 976
Exports	72, 568	82, 978	89, 419	101, 059
Apparent consumption	6, 157, 485		5, 478, 180	

[1] Dominion Bureau of Statistics.

STONE

By Oliver Bowles and M. Schauble

SUMMARY OUTLINE

The stone industries in 1938 failed to maintain the gains won in 1936 and 1937. Sales of both crushed and dimension stone dropped 6 percent in quantity and 5 percent in value compared with 1937. Dimension-stone sales (exclusive of slate) declined 6 percent in quantity and 10 percent in value, while crushed-stone sales (excluding that used for lime and cement manufacture) dropped 6 percent in quantity and 4 percent in value. Sales of stone depend to an unusual degree on the volume of building and highway construction. The building industries made substantial gains during the late months of 1938, with consequent stimulation of stone production, but the increase in output during that period was insufficient to overcome the decline in sales early in the year. Detailed figures of sales of stone by kinds and uses appear in following sections.

The present chapter follows the general plan of the chapter on Stone in Minerals Yearbook, 1938, 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, 1934–38, 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
1934	6,791,850	$14,889,155	11,642,830	$11,269,853	177,280	$3,370,917	57,501,510	$53,790,846
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

Year	Sandstone		Other stone [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	3,605,420	$4,714,284	12,344,940	$10,944,881	92,063,830	$98,979,936
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

[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, 1937–38, by uses

Use	1937		1938	
	Quantity	Value	Quantity	Value
Dimension stone:				
Building stone:				
Rough construction ... short tons	550,740	$1,164,921	463,720	$905,536
Cut stone, slabs, and mill blocks ... cubic feet	7,950,860	11,977,753	7,135,860	10,989,024
Approximate equivalent in short tons	608,200		541,870	
Rubble ... short tons	250,620	333,761	370,060	426,796
Monumental stone ... cubic feet	3,018,210	8,426,623	2,450,930	7,359,184
Approximate equivalent in short tons	249,050		201,680	
Paving blocks ... number	7,879,944	781,259	4,300,930	462,729
Approximate equivalent in short tons	73,900		38,220	
Curbing ... cubic feet	1,219,100	1,139,206	1,375,920	1,217,091
Approximate equivalent in short tons	98,390		109,170	
Flagging ... do	627,010	509,014	488,340	417,802
Approximate equivalent in short tons	50,330		41,400	
Total dimension stone (quantities approximate, in short tons)	1,881,230	24,332,537	1,766,120	21,778,162
Crushed and broken stone:				
Riprap ... short tons	5,388,920	5,850,101	6,210,520	6,995,418
Crushed stone ... do	88,432,570	82,824,608	94,763,050	88,767,221
Furnace flux (limestone and marble) ... do	21,331,970	14,704,458	9,702,860	6,943,429
Refractory stone [1] ... do	1,525,260	2,258,900	659,690	991,765
Agricultural (limestone) ... do	5,004,930	6,454,695	4,367,410	5,637,485
Other uses [2] ... do	9,578,360	9,787,829	7,369,290	8,141,566
Total crushed and broken stone ... do	131,262,010	121,880,591	123,072,820	117,476,884
Grand total (quantities approximate, in short tons)	133,143,240	146,213,128	124,838,940	139,255,046

[1] Ganister, sandstone, mica schist, soapstone, and dolomite.
[2] Includes roofing granules, as follows: 1937, 168,150 tons valued at $761,928; 1938, 171,389 tons, $666.917. There were also produced slate granules used for roofing as follows: 1937, 277,010 tons valued at $1,578,014; 1938, 349,000 tons, $2,489,962. These figures are included in the chapter on Slate in this volume.

Stone sold or used by noncommercial producers in the United States in 1938, by uses

Use	Short tons	Value	Use	Short tons	Value
Dimension stone:			Crushed and broken stone:		
Building stone	20,970	$113,948	Riprap	2,004,570	$3,199,288
Rubble	80,710	111,992	Crushed stone	34,508,880	35,785,401
Curbing	4,780	39,231	Agricultural (limestone)	423,640	579,331
Flagging	290	2,250	Other uses	167,810	168,815
			Total crushed and broken	37,104,900	39,732,835
Total dimension stone	106,750	267,421	Grand total	37,211,650	40,000,256

Stone sold or used by producers in the United States, 1937–38, by States

State	1937			1938		
	Active plants	Short tons (approximate)	Value	Active plants	Short tons (approximate)	Value
Alabama	22	[1] 1,500,860	[1] $1,573,890	54	1,326,160	$1,809,379
Alaska	4	[1] 38,450	[1] 59,845	12	189,090	204,232
Arizona	37	754,170	983,073	28	431,310	337,078
Arkansas	23	476,370	485,685	31	[1] 308,760	[1] 293,497
California	220	8,356,260	7,007,329	183	7,634,260	6,632,719
Colorado	60	[1] 1,018,100	[1] 814,930	71	897,270	1,051,333
Connecticut	30	[1] 1,661,630	[1] 1,859,648	32	1,529,730	1,731,707
Delaware	2	[2]	[2]	2	[2]	[2]
District of Columbia	2	[2]	[2]	1	[2]	[2]
Florida	38	1,600,380	1,408,749	39	[1] 1,349,160	[1] 1,223,438
Georgia	73	1,737,760	3,597,039	89	1,465,680	3,581,319
Hawaii	19	[1] 633,430	[1] 948,113	17	515,140	727,194
Idaho	24	891,270	700,627	39	1,047,980	795,896
Illinois	260	[1] 9,887,260	[1] 8,383,931	250	[1] 8,528,440	[1] 7,335,844
Indiana	145	[1] 3,504,530	[1] 6,397,891	213	[1] 3,782,410	[1] 6,486,996
Iowa	221	4,294,310	4,276,891	228	3,369,750	3,782,480
Kansas	499	[1] 3,540,860	[1] 4,763,080	237	[1] 3,676,230	[1] 4,958,723
Kentucky	118	[1] 3,433,190	[1] 3,040,322	134	[1] 3,361,600	[1] 2,987,494
Louisiana	2	[2]	[2]	1	[2]	[2]
Maine	43	[1] 265,340	[1] 1,546,037	35	192,250	1,161,535
Maryland	51	[1] 836,800	[1] 1,139,767	46	[1] 947,390	[1] 1,167,518
Massachusetts	60	[1] 2,353,500	[1] 4,408,297	67	[1] 2,188,820	[1] 3,865,042
Michigan	35	[1] 12,347,790	[1] 6,553,610	43	[1] 7,900,370	[1] 4,059,590
Minnesota	103	[1] 822,680	[1] 1,991,199	126	941,050	1,914,056
Mississippi	1	[2]	[2]			
Missouri	215	[1] 3,635,250	[1] 4,742,459	294	3,332,480	4,458,781
Montana	30	[1] 340,450	[1] 439,785	38	1,364,680	1,717,417
Nebraska	23	763,710	1,146,335	24	[1] 510,240	[1] 780,664
Nevada	8	[1] 76,340	[1] 66,217	12	344,760	246,319
New Hampshire	22	71,090	442,772	20	53,790	444,537
New Jersey	39	[1] 2,379,590	[1] 2,621,038	35	2,583,220	2,678,766
New Mexico	23	713,500	302,723	14	[1] 698,350	[1] 438,284
New York	291	10,882,980	11,244,495	247	10,061,250	10,527,452
North Carolina	122	2,624,770	3,314,634	145	[1] 4,552,120	[1] 5,789,486
North Dakota	3	44,570	15,012	8	20,090	5,395
Ohio	184	10,306,140	9,426,808	221	[1] 9,888,730	[1] 8,970,552
Oklahoma	57	1,098,790	1,149,624	78	[1] 1,101,320	[1] 1,338,858
Oregon	101	[1] 2,010,490	[1] 1,442,916	142	[1] 2,355,970	[1] 2,025,335
Pennsylvania	317	16,091,160	17,251,160	362	12,134,290	13,045,423
Puerto Rico	14	[1] 166,150	[1] 182,109	43	[1] 239,610	[1] 247,896
Rhode Island	13	[1] 113,990	[1] 477,729	16	[1] 262,910	[1] 601,355
South Carolina	21	936,880	1,462,738	16	[1] 987,280	[1] 1,315,999
South Dakota	52	[1] 407,270	[1] 982,906	93	320,740	899,190
Tennessee	115	[1] 2,720,750	[1] 3,979,159	149	[1] 2,599,840	[1] 4,237,351
Texas	82	[1] 2,149,320	[1] 2,218,643	96	3,256,240	2,625,281
Utah	23	453,540	315,985	26	[1] 709,430	[1] 390,249
Vermont	34	[1] 194,770	[1] 4,215,766	80	264,480	3,148,950
Virginia	162	[1] 5,061,660	[1] 5,399,137	191	5,474,690	5,606,470
Washington	77	2,027,420	1,909,604	116	[1] 2,321,210	[1] 1,849,051
West Virginia	168	[1] 3,510,040	[1] 3,696,556	243	[1] 3,194,980	[1] 4,391,563
Wisconsin	205	3,331,670	4,284,003	207	3,097,230	3,880,935
Wyoming	14	[1] 342,710	[1] 287,957	11	252,170	346,018
Undistributed		733,300	1,254,905		1,273,990	1,140,399
	4,507	133,143,240	146,213,128	4,905	124,838,940	139,255,046

[1] To avoid disclosing confidential information certain State totals are slightly incomplete, the figures not included being combined under "Undistributed."
[2] Included under "Undistributed."

If sales in 1938 are compared with those in 1937 declines in all branches of the dimension-stone industries except rubble and curbing are evident. Sales of both crushed stone and riprap were considerably larger in 1938 than in 1937, but the output of furnace flux and refractory stone fell to unusually low levels.

DIMENSION STONE

Total sales of dimension stone in 1938 declined 7 percent in quantity and 12 percent in value from 1937. These figures include slate, but details of the slate industry are given in a separate chapter of this volume. Sales of all varieties except miscellaneous stone were lower than in 1937; the latter, however, made a substantial gain in quantity but suffered a loss in value.

The following table of salient statistics includes final figures for both 1937 and 1938 and the percentage of change from 1937 for each type of stone by principal products.

Dimension stone sold or used by producers in the United States, 1937–38, by kinds and uses

Kind and use	1937	1938	
		Total	Percent of change
Granite:			
Building stone:			
Rough construction ... short tons	172,480	202,640	+17.5
Value	$386,267	$343,984	−10.9
Average per ton	$2.24	$1.70	−24.1
Cut stone, slabs, and mill blocks ... cubic feet	1,240,040	967,410	−22.0
Value	$2,681,888	$2,460,649	−8.2
Average per cubic foot	$2.16	$2.54	+17.6
Rubble ... short tons	111,140	108,220	−2.6
Value	$149,958	$127,372	−15.1
Monumental stone ... cubic feet	2,657,630	2,092,540	−21.3
Value	$6,628,447	$5,650,996	−14.7
Average per cubic foot	$2.49	$2.70	+8.4
Paving blocks ... number	7,866,994	4,165,230	−47.1
Value	$780,611	$452,542	−42.0
Curbing ... cubic feet	881,310	894,970	+1.5
Value	$825,148	$742,489	−10.0
Total:			
Quantity ... approximate short tons	751,330	672,630	−10.5
Value	$11,452,319	$9,778,032	−14.6
Basalt and related rocks (trap rock):			
Building stone:			
Rough construction ... short tons	16,170	7,970	−50.7
Value	$21,482	$11,654	−45.7
Average per ton	$1.33	$1.46	+9.8
Rubble ... short tons	8,930	13,880	+55.4
Value	$6,478	$9,897	+52.8
Total:			
Quantity ... short tons	25,100	21,850	−12.9
Value	$27,960	$21,551	−22.9
Marble:			
Building stone (cut stone, slabs, and mill blocks) ... cubic feet	731,700	687,290	−6.1
Value	$3,336,545	$3,264,877	−2.1
Average per cubic foot	$4.56	$4.75	+4.2
Monumental stone ... cubic feet	360,580	358,390	−0.6
Value	$1,798,176	$1,708,188	−5.0
Average per cubic foot	$4.99	$4.77	−4.4
Total:			
Quantity ... approximate short tons	95,460	89,000	−6.8
Value	$5,134,721	$4,473,065	−3.1

Dimension stone sold or used by producers in the United States, 1937–38, by kinds and uses—Continued

Kind and use	1937	1938 Total	1938 Percent of change
Limestone:			
Building stone:			
Rough construction ... short tons	191,660	166,260	−13.3
Value	$380,324	$316,772	−16.7
Average per ton	$1.98	$1.91	−3.5
Cut stone, slabs, and mill blocks ... cubic feet	5,455,050	5,077,950	−6.9
Value	$4,716,211	$4,350,724	−7.7
Average per cubic foot	$0.86	$0.86	
Rubble ... short tons	107,550	155,370	+44.5
Value	$136,028	$194,621	+43.1
Flagging ... cubic feet	167,950	95,880	−42.9
Value	$76,806	$74,560	−2.9
Total:			
Quantity ... approximate short tons	713,580	704,080	−1.3
Value	$5,309,369	$4,936,677	−7.0
Sandstone:			
Building stone:			
Rough construction ... short tons	113,880	64,290	−43.5
Value	$294,657	$190,419	−35.4
Average per ton	$2.59	$2.96	+14.3
Cut stone, slabs, and mill blocks ... cubic feet	455,120	332,530	−26.9
Value	$650,295	$440,444	−32.3
Average per cubic foot	$1.43	$1.32	−7.7
Rubble ... short tons	22,700	10,990	−51.6
Value	$41,297	$23,703	−42.6
Paving blocks ... number	12,950	135,700	+947.9
Value	$648	$10,187	+1,472.1
Curbing ... cubic feet	337,790	480,950	+42.4
Value	$314,058	$474,602	+51.1
Flagging ... cubic feet	445,280	372,050	−16.4
Value	$419,788	$334,322	−20.4
Total:			
Quantity ... approximate short tons	231,630	166,120	−28.3
Value	$1,720,743	$1,473,677	−14.4
Miscellaneous stone:[1]			
Building stone ... cubic feet	739,750	332,700	−55.0
Value	$675,005	$515,037	−23.7
Average per cubic foot	$0.91	$1.55	+70.3
Rubble ... short tons		81,600	
Value		$71,203	
Flagging ... cubic feet	13,780	20,410	+48.1
Value	$12,420	$8,920	−28.2
Total:			
Quantity ... approximate short tons	64,130	112,440	+75.3
Value	$687,425	$595,160	−13.4
Total, exclusive of slate:			
Quantity ... approximate short tons	1,881,230	1,766,120	−6.1
Value	$24,332,537	$21,778,162	−10.5
Slate as dimension stone[2] ... approximate short tons	167,550	143,690	−14.2
Value	$4,027,308	$3,165,351	−21.4
Total, including slate:			
Quantity ... approximate short tons	2,048,780	1,909,810	−6.8
Value	$28,359,845	$24,943,513	−12.0

[1] Includes soapstone, mica schist, volcanic rocks, argillite, and other varieties that cannot be classified in the principal groups.
[2] Details of production, by uses, are given in the 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 1937 and 1938.

Building stone sold or used by producers in the United States in 1938, by kinds

Kind	Rough			
	Construction		Architectural	
	Cubic feet	Value	Cubic feet	Value
Granite	2,449,520	$343,984	311,570	$238,820
Basalt	94,470	11,654		
Marble			159,530	376,400
Limestone	2,006,460	316,772	2,455,580	895,791
Sandstone	829,450	190,419	64,100	42,389
Miscellaneous	262,020	42,707		
	5,641,920	905,536	2,990,780	1,553,400

Kind	Finished				Total	
	Sawed [1]		Cut [1]			
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
Granite	351,210	$719,730	304,630	$1,502,099	3,416,930	$2,304,633
Basalt					94,470	11,654
Marble	149,650	423,977	378,110	2,464,500	687,290	3,264,877
Limestone	1,030,350	654,515	1,592,020	2,800,418	7,084,410	4,667,496
Sandstone	188,650	224,690	79,780	173,365	1,161,980	630,863
Miscellaneous			70,680	472,330	332,700	515,037
	1,719,860	2,022,912	2,425,220	7,412,712	12,777,780	11,894,560

[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 all granite products receded in 1938 both in quantity and value except rough construction stone and curbing, both of which gained in quantity but declined in value. The following table shows production by States and uses in 1938.

Granite (dimension stone) sold or used by producers in the United States in 1938, 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: Dressed: Cubic feet	Building: Dressed: Value	Building: Rubble: Short tons	Building: Rubble: Value	Monumental: Rough: Cubic feet	Monumental: Rough: Value	Monumental: Dressed: Cubic feet	Monumental: Dressed: Value	Paving blocks: Number	Paving blocks: Value	Curbing: Cubic feet	Curbing: Value	Total: Short tons (approximate)	Total: Value
California	14	740	$1,381	1,860	$3,255	-------	-------	2,960	$1,184	11,620	$22,139	4,360	$18,676	-------	-------	3,800	$5,139	5,460	$51,774
Colorado	9	-------	-------	(1)	(1)	-------	-------	-------	-------	2,300	4,534	2,950	13,377	-------	-------	-------	-------	(1)	(1)
Connecticut	10	6,320	22,517	2,580	2,587	(1)	(1)	(1)	(1)	4,820	19,924	(1)	(1)	1,000	$236	18,590	22,115	13,480	164,094
Delaware	1	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)
Georgia	20	12,300	10,784	(1)	(1)	25,180	$62,351	27,440	19,551	518,750	544,371	64,440	307,155	(1)	(1)	101,510	65,200	100,510	1,021,939
Maine	19	5,290	12,934	62,300	45,824	170,870	487,658	5,740	5,875	9,810	12,093	3,730	10,424	3,009,930	341,787	24,780	14,869	59,420	931,464
Maryland	7	94,130	150,992	3,000	5,186	7,850	20,754	2,430	3,032	-------	-------	-------	-------	-------	-------	6,270	1,571	97,960	181,535
Massachusetts	24	9,590	8,042	23,140	23,844	281,740	831,380	(1)	(1)	27,710	59,459	(1)	(1)	332,740	28,029	533,090	491,303	113,180	1,575,832
Minnesota	28	-------	-------	130,730	70,489	14,820	70,294	-------	-------	196,100	192,835	60,440	379,285	-------	-------	-------	-------	33,380	712,903
Missouri	4	830	1,627	1,500	3,000	-------	-------	-------	-------	8,830	15,720	1,800	6,500	-------	-------	-------	-------	1,850	26,847
Montana	8			210	213	200	580	-------	-------	1,820	3,463	480	3,685	-------	-------	-------	-------	230	7,941
New Hampshire	12	3,340	1,840	16,330	12,144	57,290	297,569	(1)	(1)	5,500	10,262	(1)	(1)	58,050	3,339	7,670	9,011	19,090	382,822
New Jersey	1	(1)	(1)	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)
New York	4	3,700	20,875	1,300	9,100	2,870	17,236	(1)	(1)	-------	-------	-------	-------	(1)	(1)	(1)	(1)	8,690	55,409
North Carolina	10	7,800	22,659	2,290	1,887	41,330	210,335	1,600	3,527	30,090	44,289	7,260	62,928	18,000	982	188,020	125,633	31,260	472,240
Oklahoma	7	(1)	(1)	-------	-------	-------	-------	(1)	(1)	54,290	167,989	12,030	110,178	-------	-------	(1)	(1)	6,140	279,005
Oregon	2	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	(1)	(1)	-------	-------	-------	-------	(1)	(1)
Pennsylvania	13	54,860	83,794	1,920	7,765	(1)	(1)	15,740	16,408	(1)	(1)	22,120	93,686	(1)	(1)	2,530	1,218	73,860	226,125
Rhode Island	4	(1)	(1)	-------	-------	-------	-------	6,140	4,906	38,230	148,183	(1)	(1)	-------	-------	-------	-------	10,330	211,062
South Carolina	5	-------	-------	(1)	(1)	-------	-------	(1)	(1)	(1)	(1)	(1)	(1)	-------	-------	(1)	(1)	12,190	165,133
South Dakota	8	-------	-------	12,990	7,202	(1)	(1)	-------	-------	(1)	(1)	68,060	520,545	-------	-------	-------	-------	11,990	568,426
Texas	6	(1)	(1)	(1)	(1)	-------	-------	(1)	(1)	20,410	28,672	(1)	(1)	-------	-------	(1)	(1)	4,460	44,477
Vermont	13	-------	-------	(1)	(1)	(1)	(1)	-------	-------	605,790	1,849,890	(1)	(1)	-------	-------	-------	-------	50,130	1,909,895
Virginia	2	(1)	(1)	(1)	(1)	-------	-------	-------	-------	(1)	(1)	-------	-------	(1)	(1)	(1)	(1)	(1)	(1)
Washington	3	-------	-------	-------	-------	130	1,131	-------	-------	380	673	2,200	26,134	-------	-------	-------	-------	220	27,938
Wisconsin	17	(1)	(1)	(1)	(1)	7,970	77,754	2,010	2,012	12,180	23,489	43,850	515,438	(1)	(1)	-------	-------	12,210	688,641
Undistributed	-------	3,740	6,539	51,420	46,324	45,590	144,787	44,160	70,877	212,560	197,804	37,630	237,196	745,510	78,169	8,710	6,430	6,590	72,530
	251	202,640	343,984	311,570	238,820	655,840	2,221,829	108,220	127,372	1,761,190	3,345,789	331,350	2,305,207	4,165,230	452,542	894,970	742,489	672,630	9,778,032
Short tons (approximate)	-------	(2)	-------	25,990	-------	54,220	-------	-------	-------	145,060	-------	26,250	-------	36,890	-------	73,360	-------	-------	-------

[1] Included under "Undistributed."

[2] 2,449,520 cubic feet (approximate).

The following tables show sales of monumental granite in the important Quincy (Mass.) and Barre (Vt.) centers.

Monumental granite sold by the quarrymen at Quincy, Mass., 1934–38 [1]

Year	Active plants	Cubic feet	Value	Year	Active plants	Cubic feet	Value
1934	3	56,290	$100,879	1937	3	36,020	$80,248
1935	3	63,450	95,529	1938	3	33,360	73,832
1936	3	46,570	85,013				

[1] Quincy granite is sold also for construction, curbing, rubble, riprap, and crushed stone.

Monumental granite sold by the quarrymen in the Barre district, Vermont, 1934–38 [1]

Year	Cubic feet	Value	Year	Cubic feet	Value
1934	709,820	$1,878,644	1937	847,740	$2,390,377
1935	676,820	1,844,006	1938	605,660	1,849,607
1936	771,230	2,109,526			

[1] Barre granite is sold also for construction, paving blocks, and crushed stone.

Estimated output of monumental granite in Barre district, Vermont, 1935–37 [1]

	1935	1936	1937
Total quarry output, rough stock cubic feet	668,838	775,626	765,390
Shipped out of Barre district in rough do	133,768	155,125	153,078
Manufactured in Barre district do	535,070	620,501	612,312
Light stock consumed in district do	418,024	484,766	478,369
Dark stock consumed in district do	250,814	290,860	287,021
Number of cutters in district	1,240	1,550	1,550
Average daily wage	$8.00	$8.00	$8.00
Average number of days worked	225	230	230
Total pay roll for year	$2,232,000	$2,852,000	$2,852,000
Estimated overhead	1,116,000	1,426,000	1,426,000
Estimated value of light stock	1,358,577	1,575,490	1,554,699
Estimated value of dark stock	1,003,257	1,163,440	1,234,191
Estimated polishing cost	423,174	490,739	484,263
Output from saws	141,058	163,580	161,421
Total value of granite	6,274,066	7,671,249	7,712,574

[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; figures for 1938 not yet available.

BASALT AND RELATED ROCKS (TRAP ROCK)

Because of its dark color basalt is not used extensively for building. As the table of salient statistics indicates, sales for building were only about half as great in 1938 as in 1937. Sales of rubble, however, made substantial gains. The following table shows production by States in 1938.

Basalt and related 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 1938, by States and uses

State	Active plants	Building stone				Total	
		Rough construction		Rubble			
		Short tons	Value	Short tons	Value	Short tons	Value
California	2			(1)	(1)	(1)	(1)
Connecticut	2	(1)	(1)			(1)	(1)
Massachusetts	1			540	$268	540	$268
New Jersey	1	80	$82			80	82
Oregon	3	1,290	3,668			1,290	3,668
Pennsylvania	3	(1)	(1)	(1)	(1)	3,190	5,483
Virginia	2	(1)	(1)	(1)	(1)	(1)	(1)
Undistributed		6,600	7,904	13,340	9,629	16,750	12,050
	14	[2] 7,970	11,654	13,880	9,897	21,850	21,551

[1] Included under "Undistributed." [2] 94,470 cubic feet (approximate).

MARBLE

Sales of marble in 1938 dropped 7 percent in quantity and 3 percent in value. The decline would have been much greater were it not for the large gains by Tennessee which supplied exterior marble for the National Gallery of Art in Washington, D. C.

Marble sold by producers in the United States, 1937–38, by uses

Use	1937		1938	
	Quantity	Value	Quantity	Value
Building stone:				
Rough:				
Exterior ... cubic feet	25,100	$36,925	13,880	$24,424
Interior ... do	155,620	484,956	145,650	351,976
Finished:				
Exterior ... do	259,400	901,645	258,030	1,183,841
Interior ... do	291,580	1,913,019	269,730	1,704,636
Total exterior ... do	284,500	938,570	271,910	1,208,265
Total interior ... do	447,200	2,397,975	415,380	2,056,612
Total building stone ... do	731,700	3,336,545	687,290	3,264,877
Monumental stone:				
Rough ... do	76,090	91,560	69,850	85,181
Finished ... do	284,490	1,706,616	288,540	1,623,007
Total monumental stone ... do	360,580	1,798,176	358,390	1,708,188
Total building and monumental ... do	1,092,280	5,134,721	1,045,680	4,973,065
Total building and monumental ... approximate short tons	95,460		89,000	

Marble (dimension stone) sold by producers in the United States in 1938, 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	29,060	$213,816	36,170	$153,946	65,230	5,540	$367,762
Alaska	1	(2)	(2)			(2)	(2)	(2)
Arkansas	4	8,270	11,288			8,270	700	11,288
Colorado	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Georgia	1	47,400	351,819	151,180	679,302	198,580	16,880	1,031,121
Maryland	1	5,810	48,425			5,810	500	48,425
Massachusetts	2	18,470	38,966	2,250	16,704	20,720	2,740	55,670
Minnesota	1	(2)	(2)			(2)	(2)	(2)
Missouri	4	131,780	356,285	8,450	18,831	140,230	11,170	375,116
New York	2	(2)	(2)	(2)	(2)	(2)	(2)	(2)
North Carolina	1	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Tennessee	7	330,170	1,725,809	12,440	54,152	342,610	29,130	1,779,961
Vermont	6	74,000	297,384	138,080	705,997	212,080	17,950	1,003,381
Wisconsin	1	(2)	(2)			(2)	(2)	(2)
Undistributed		42,330	221,085	9,820	79,256	52,150	4,390	300,341
	35	687,290	3,264,877	358,390	1,708,188	1,045,680	89,000	4,973,065
Short tons (approximate)		58,630		30,370				

[1] Includes 16,680 cubic feet of serpentine marble (verde antique) valued at $132,761, which was sold as building and ornamental stone.
[2] Included under "Undistributed."

LIMESTONE

Limestone is used more extensively than any other type of building stone in the United States, and Indiana supplied 82 percent of the total architectural limestone (rough and finished) sold in 1938. Sales of cut stone, slabs, and mill blocks, which comprise the major products of the industry, decreased 7 percent in quantity and 8 percent in value in 1938 compared with 1937. The average price per cubic foot was 86 cents, the same as in 1937. Sales of stone for rough construction and for flagging declined greatly, but those of rubble made substantial gains.

Limestone (dimension stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	Building								Flagging		Total	
		Rough construction		Rough architectural		Finished (cut and sawed)		Rubble					
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Cubic feet	Value	Short tons (approximate)	Value
Alabama	1			(1)	(1)	(1)	(1)					(1)	(1)
California	7	1,370	$3,991	(1)	(1)			900	$726	(1)	(1)	2,320	$7,178
Colorado	3			8,600	$15,604							690	15,604
Florida	6	9,080	5,216	(1)	(1)	(1)	(1)			17,800	$25,454	14,780	114,054
Georgia	1	(1)	(1)									(1)	(1)
Illinois	7	(1)	(1)					4,160	7,471	(1)	(1)	47,360	64,714
Indiana	21	(1)	(1)	2,691,400	621,751	2,061,800	$2,605,983	2,650	2,062	(1)	(1)	303,950	3,231,421
Iowa	5	2,410	1,935					(1)	(1)	(1)	(1)	3,240	3,007
Kansas	8	24,300	44,750	(1)	(1)			37,120	45,231	(1)	(1)	62,820	96,231
Kentucky	10	12,500	8,845	9,420	12,000	(1)	(1)	6,090	2,357	(1)	(1)	19,680	27,259
Maryland	4	(1)	(1)					(1)	(1)			1,570	5,299
Michigan	2	(1)	(1)									(1)	(1)
Minnesota	8	(1)	(1)	58,400	38,723	(1)	(1)	9,770	15,981	(1)	(1)	21,320	255,091
Missouri	17	3,870	5,700			(1)	(1)	33,680	54,679	(1)	(1)	38,700	76,606
Montana	1			(1)	(1)							(1)	(1)
Nebraska	2	(1)	(1)									(1)	(1)
New York	2	(1)	(1)					(1)	(1)			(1)	(1)
Ohio	15	11,720	16,352					(1)	(1)	(1)	(1)	13,330	17,664
Oklahoma	1							(1)	(1)			(1)	(1)
Pennsylvania	22	14,750	15,007					12,580	12,268	4,940	1,130	27,740	28,405
South Dakota	1							1,500	1,799			1,500	1,799
Tennessee	1							(1)	(1)			(1)	(1)
Texas	4	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	29,150	328,374
Vermont	1							(1)	(1)			(1)	(1)
Virginia	1							(1)	(1)			(1)	(1)
Wisconsin	19	28,210	124,046	(1)	(1)	73,840	83,606	35,840	41,495	(1)	(1)	79,550	322,250
Wyoming	1			(1)	(1)							(1)	(1)
Undistributed		58,050	90,930	287,760	207,713	486,730	765,344	11,080	10,552	73,140	47,976	36,380	341,721
	171	166,260	316,772	2,455,580	895,791	2,622,370	3,454,933	155,370	194,621	95,880	74,560	704,080	4,936,677
Short tons (approximate)		(2)		179,740		192,710				10,000			

[1] Included under "Undistributed."

[2] 2,006,460 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, 1934–38, by classes

Year	Construction					
	Rough block		Sawed and semifinished		Cut	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1934	1, 226, 420	$447, 299	445, 440	$342, 997	1, 123, 650	$1, 896, 886
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

Year	Construction—Continued			Other uses		Total	
	Total						
	Cubic feet	Short tons (approximate)	Value	Short tons	Value	Short tons	Value
1934	2, 795, 510	203, 000	$2, 687, 182	183, 510	$94, 611	386, 510	$2, 781, 793
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

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, 1934–38, by classes

Year	Sawed and semifinished		Cut		Total	
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value
1934	58, 940	$75, 384	589, 810	$1, 056, 293	648, 750	$1, 131, 677
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:						
Mills not operated by quarry companies	33, 680	15, 274	508, 700	811, 416	542, 380	826, 690
Mills of quarry companies from stock obtained at quarries other than their own	76, 990	54, 622	627, 710	891, 838	704, 700	946, 460
	110, 670	69, 896	1, 136, 410	1, 703, 254	1, 247, 080	1, 773, 150

Limestone and marble sold by producers in the Carthage district, Jasper County, Mo., 1934–38, 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	Value
1934	33,020	$81,555	6,110	$10,722	39,130	3,260	$92,277	41,090	$39,159	44,350	$131,436
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

Limestone and marble sold by producers at Mankato and Kasota, Minn., 1934–38

Year	Building stone (rough and dressed)		Other uses		Total	
	Cubic feet	Value	Short tons	Value	Short tons (approximate)	Value
1934	99,010	$188,484	13,940	$10,119	21,360	$198,603
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

[1] Bureau of Mines not at liberty to publish figures.
[2] Exclusive of "Other uses."

SANDSTONE

Sales of cut stone, slabs, and mill blocks of sandstone declined 27 percent in quantity and 32 percent in value in 1938. The output of stone for rough construction and rubble decreased greatly. Sales of paving blocks, which had dwindled almost to the vanishing point in 1937, increased more than tenfold in 1938. The output of curbing was much larger than in 1937, but sales of flagging were smaller. The average value of rough construction stone at the mill or quarry was higher than in 1937, and that of cut stone was lower.

Sandstone (dimension stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	Building								Paving blocks		Curbing		Flagging		Total	
		Rough construction		Rough architectural		Dressed (sawed and cut)		Rubble									
		Short tons	Value	Cubic feet	Value	Cubic feet	Value	Short tons	Value	Number	Value	Cubic feet	Value	Cubic feet	Value	Short tons (approximate)	Value
Arizona	3	3,050	$4,565											400	$1,710	3,080	$6,275
California	4	24,910	13,534	[1]	[1]			[1]	[1]					18,690	10,152	27,280	25,054
Colorado	3	3,840	13,107											750	780	3,900	13,887
Connecticut	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	5	1,360	1,738											36,960	9,494	4,310	11,232
Massachusetts	1	[1]	[1]	[1]	[1]	[1]	[1]									[1]	[1]
Minnesota	1							[1]	[1]	[1]	[1]					[1]	[1]
New Jersey	1	[1]	[1]													[1]	[1]
New York	22	1,130	3,448	7,090	$3,799	[1]	[1]	[1]	[1]	[1]	[1]	158,250	$171,118	83,130	54,057	25,060	290,334
Ohio	9	8,430	84,180	46,570	22,020	235,920	$297,073	270	$1,067			278,980	258,760	96,150	94,547	54,960	757,647
Pennsylvania	25	11,720	32,269			1,900	5,856	7,360	13,844			43,720	44,724	90,510	112,317	30,320	209,010
Tennessee	3	[1]	[1]					[1]	[1]					24,240	40,418	7,340	66,341
Virginia	7	2,180	3,241											14,190	4,674	3,180	7,915
Washington	1					2,490	13,695	200	468					2,030	2,563	560	16,726
Wisconsin	2	1,250	4,700	2,400	2,400									500	160	1,470	7,260
Undistributed		6,420	29,637	8,040	14,170	28,120	81,431	3,160	8,324	135,700	$10,187			4,500	3,450	4,660	61.996
	91	64,290	190,419	64,100	42,389	268,430	398,055	10,990	23,703	135,700	10,187	480,950	474,602	372,050	334,322	166,120	1,473,677
Short tons (approximate)		[2]		4,450		19,770				1,330		35,810		29,480			

[1] Included under "Undistributed."

[2] 829,450 cubic feet (approximate).

Bluestone sold or used by producers in the United States (all from New York and Pennsylvania) in 1938, by uses [1]

State	Dimension stone										Other uses	
	Building		Curbing		Flagging		Total					
	Cubic feet	Value	Cubic feet	Value	Cubic feet	Value	Cubic feet	Short tons (approximate)	Value		Short tons	Value
New York	29,830	$51,402	118,270	$133,028	81,370	$51,369	229,470	19,390	$235,799		16,700	$16,435
Pennsylvania	5,920	6,555	18,720	19,724	75,560	107,779	100,200	8,470	134,058		------	------
	35,750	57,957	136,990	152,752	156,930	159,148	329,670	27,860	369,857		16,700	16,435

[1] Included in foregoing figures for sandstone.

MISCELLANEOUS STONE

The following table includes certain types of dimension stone not included in any of the groups already discussed. The principal varieties are mica schist, argillite, various light-colored volcanic rocks, and soapstone.

Miscellaneous varieties of stone (dimension stone) sold or used by producers in the United States in 1938, 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
Alaska	1	------	------	(1)	(1)	------	------	(1)	(1)
California	6	(1)	(1)	(1)	(1)	------	------	3,090	$4,222
District of Columbia	1	------	------	(1)	(1)	------	------	(1)	(1)
Florida	1	------	------	(1)	(1)	------	------	(1)	(1)
Georgia	2	(1)	(1)	------	------	(1)	(1)	(1)	(1)
Maryland	4	4,830	$12,190	(1)	(1)	(1)	(1)	8,130	17,869
Nevada	1	------	------	(1)	(1)	------	------	(1)	(1)
New Jersey	2	(1)	(1)	------	------	------	------	(1)	(1)
New York	3	(1)	(1)	------	------	(1)	(1)	1,120	3,528
Pennsylvania	8	14,150	21,585	------	------	------	------	14,150	21,585
Puerto Rico	1	(1)	(1)	------	------	------	------	(1)	(1)
Virginia	2	(1)	(1)	------	------	------	------	(1)	(1)
Undistributed	------	9,940	481,262	81,600	$71,203	1,920	$8,920	85,950	547,956
	32	[2] 28,920	515,037	81,600	71,203	[2] 1,920	8,920	112,440	595,160

[1] Included under "Undistributed."
[2] Building stone, approximately 332,700 cubic feet; flagging, approximately 20,410 cubic feet.

TRENDS IN THE USE OF BUILDING AND MEMORIAL STONE

Total building activity (residential plus nonresidential) in 1938 was just about the same as in 1937, while nonresidential building, where stone finds its chief market, receded moderately from the level of 1937. As indicated in figures 1 and 2, sales of building granite and

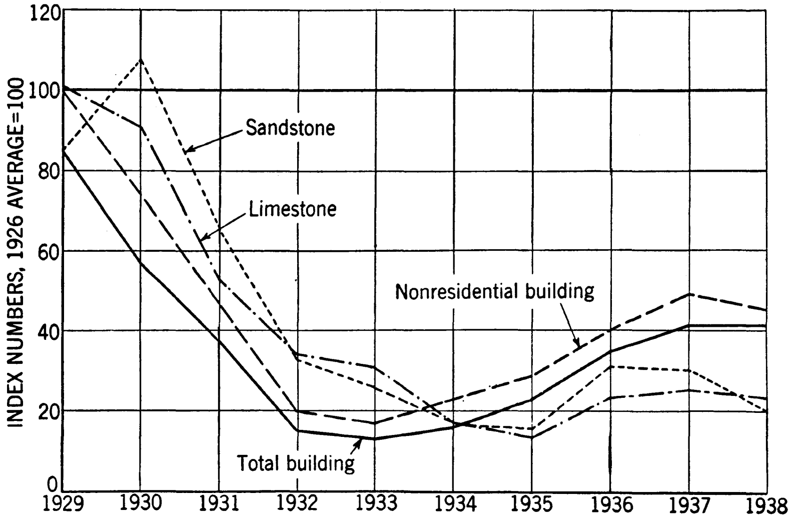

FIGURE 1.—Sales value of limestone and sandstone compared with total building and nonresidential building, 1929–38. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

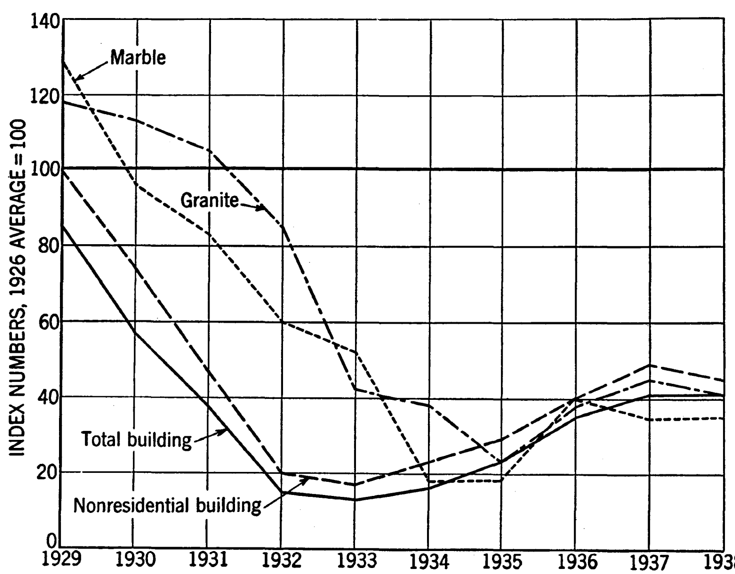

FIGURE 2.—Sales value of building marble and granite compared with total building and nonresidential building, 1929–38. To facilitate comparison, unlike units have been reduced to percentages of the 1926 value. Stone figures include rough and dressed stone; building contracts are from F. W. Dodge Corporation.

limestone declined to about the same extent as nonresidential building, and marble sales were almost as high as in 1937, but the output of building sandstone was only about two-thirds as great as in 1937. The encouraging upturn in building contracts awarded during the late months of 1938 did not have its full effect on stone sales, because actual construction on many of the contracts did not begin until 1939. The dignity, endurance, and fire resistance of natural stone should encourage its wider use in buildings of better class. A statistical history of building stone appeared recently,[1] which showed trends during recent years and discussed reasons for declining use.

Sales of memorial granite fell 21 percent, while the output of memorial marble remained virtually the same in 1938 as in 1937.

NEW DEVELOPMENTS

In England the surfaces of limestone buildings have been cleaned effectively, even where the stone is encrusted with greasy soot, by applying a fine, misty spray of water to the surface for 1 or 2 hours before brushing.

In Europe unusually exhaustive study and research have been devoted to the weathering, discoloration, decay, frost-resistance, preservation, cleaning, and repair of building stones. These problems are of greater immediate importance in the older civilizations where stone buildings were erected centuries ago than in America where even our oldest stone structures are comparatively young from the standpoint of the life of high-grade building stone.

Blocks of natural sandstone known as "firestone" are being used to an increasing extent as refractories. Suitable material comes chiefly from the well-known sandstone area near Amherst in northern Ohio. The cementing material between the silica grains is amorphous silica, with small quantities of iron and alumina compounds. The structure is somewhat open, permitting expansion and contraction with little spalling at high temperature. Refractories of this type are well-adapted for lining soaking pits, bessemer converters, cupolas, and ladles.

Wire saws were used with fair success in 1938 in making major cuts in a marble quarry near Knoxville, Tenn. The average rate of cutting, including all delays, was 7.3 square feet per hour for a 24-hour day.

A publication [2] that may be of interest to stone producers was reprinted recently.

CRUSHED AND BROKEN STONE

More than 123,000,000 tons of crushed and broken stone were sold in 1938 exclusive of that used for making cement and lime. Sales decreased 6 percent in quantity and 4 percent in value in 1938 compared with 1937. Encouraging gains in sales for the largest uses—highway construction and concrete aggregate—were more than offset by the notable decline in stone used by the iron and steel industries. The demand for stone in manufacturing plants (except sugar factories) also receded considerably from the level of 1937. Sales of agricultural limestone declined 13 percent.

[1] Bowles, Oliver, and Schauble, Mabel, Trends in Prices and Sales of Building Stone: Stone, vol. 59, November 1938, pp. 417–418; December 1938, pp. 462–463.

[2] Bowles, Oliver, The Stone Industries: McGraw-Hill Book Co., Inc., New York. 2d ed., 1939, 519 pp.

The following table of salient statistics shows the quantity and value of crushed and broken stone sold during 1937 and 1938, 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, 1937–38, by principal uses

Use	1937			1938		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete and road metal	80, 271, 900	$76, 972, 465	$0. 96	88, 787, 080	$84, 212, 446	$0. 95
Railroad ballast	8, 160, 670	5, 852, 143	. 72	5, 975, 970	4, 554, 775	. 76
Metallurgical	21, 331, 970	14, 704, 458	. 69	9, 702, 860	6, 943, 429	. 72
Alkali works	4, 860, 520	2, 295, 599	. 47	3, 634, 050	1, 743, 173	. 48
Riprap	5, 388, 920	5, 850, 101	1. 09	6, 210, 520	6, 995, 418	1. 13
Agricultural	5, 004, 930	6, 454, 695	1. 29	4, 367, 410	5, 637, 485	1. 29
Refractory (ganister, mica schist, dolomite, soapstone)	1, 525, 260	2, 258, 900	1. 48	659, 690	991, 765	1. 50
Asphalt filler	351, 590	686, 951	1. 95	288, 590	789, 587	2. 74
Calcium carbide works	472, 240	266, 557	. 56	246, 010	137, 522	. 56
Sugar factories	566, 620	862, 660	1. 52	619, 910	878, 028	1. 42
Glass factories	274, 770	460, 352	1. 68	170, 560	290, 297	1. 70
Paper mills	322, 810	589, 091	1. 82	223, 450	373, 207	1. 67
Other uses	2, 729, 810	4, 626, 619	1. 69	2, 186, 720	3, 929, 752	1. 80
	131, 262, 010	121, 880, 591	. 93	123, 072, 820	117, 476, 884	. 95
Portland cement (including "cement rock") [1] Natural cement ("cement rock") [1]	29, 547, 000	(2)		26, 183, 000	(2)	
Lime [3]	8, 250, 000	(2)		6, 694, 000	(2)	
Total stone	169, 059, 000			155, 950, 000		
Asphaltic stone	447, 213	2, 035, 410	4. 55	483, 497	2, 409, 616	4. 98
Slate granules and flour	277, 010	1, 578, 014	5. 70	349, 000	2, 489, 962	7. 14

[1] Value reported as cement in the chapter on Cement.
[2] No value available for stone used in manufacture of cement and lime.
[3] Value reported as lime in chapter on Lime.

The following tables show production and value of stone used for concrete aggregate, road construction, and railroad ballast for a series of years and by States for 1938.

Concrete and road metal and railroad ballast sold or used by producers in the United States, 1934–38

Year	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	55, 244, 470	$52, 471, 430	5, 323, 450	$3, 995, 177	60, 567, 920	$56, 466, 607
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

Concrete and road metal, and railroad ballast sold or used by producers in the United States in 1938, by States

State	Concrete and road metal		Railroad ballast		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	464,020	$469,947			464,020	$469,947
Alaska	125,310	143,571			125,310	143,571
Arizona	[1] 365,070	[1] 278,575	(2)	(2)	[1] 365,070	[1] 278,575
Arkansas	[1] 253,450	[1] 201,120	190,910	$140,951	[1] 444,360	[1] 342,071
California	5,287,520	3,788,656	511,030	239,911	5,798,550	4,028,567
Colorado	[1] 600,180	[1] 556,833			[1] 600,180	[1] 556,833
Connecticut	[1] 1,259,110	[1] 1,197,857	168,850	143,454	[1] 1,427,960	[1] 1,341,311
Delaware	(2)	(2)			(2)	(2)
Florida	1,135,780	976,946	(2)	(2)	[1] 1,135,780	[1] 976,946
Georgia	[1] 1,177,860	[1] 1,262,234	(2)	(2)	1,229,970	1,297,791
Hawaii	[1] 467,160	[1] 685,408	(2)	(2)	505,780	724,045
Idaho	1,018,190	764,605	(2)	(2)	[1] 1,018,190	[1] 764,605
Illinois	[1] 6,767,870	[1] 5,600,395	220,130	153,755	[1] 6,988,000	[1] 5,754,150
Indiana	2,876,760	2,677,685	76,070	59,440	2,952,830	2,737,125
Iowa	2,899,530	3,352,928	(2)	(2)	[1] 2,899,530	[1] 3,352,928
Kansas	[1] 3,161,800	[1] 4,492,874	126,790	109,509	[1] 3,288,590	[1] 4,602,383
Kentucky	2,631,670	2,442,900	343,660	169,042	2,975,330	2,611,942
Louisiana	(2)	(2)			(2)	(2)
Maine	93,470	131,994			93,470	131,994
Maryland	756,100	782,475	34,140	33,888	790,240	816,363
Massachusetts	[1] 1,382,560	[1] 1,318,356	[1] 102,040	[1] 89,440	1,790,370	1,821,211
Michigan	[1] 2,218,320	[1] 1,133,246	64,640	39,173	[1] 2,282,960	[1] 1,172,419
Minnesota	795,900	798,925	1,200	1,550	797,100	800,475
Missouri	[1] 2,217,690	[1] 2,611,962	66,410	61,213	[1] 2,284,100	[1] 2,673,175
Montana	567,190	352,966	(2)	(2)	[1] 567,190	352,966
Nebraska	369,510	470,925			369,510	470,925
Nevada	56,980	80,487			56,980	80,487
New Hampshire	27,090	34,936			27,090	34,936
New Jersey	2,395,620	2,256,034	[1] 52,460	[1] 53,456	[1] 2,448,080	[1] 2,309,490
New Mexico	696,110	437,714	(2)	(2)	[1] 696,110	[1] 437,714
New York	7,854,590	8,052,850	[1] 444,270	[1] 311,408	[1] 8,298,860	[1] 8,364,258
North Carolina	3,879,090	4,603,018	623,860	668,860	4,502,950	5,271,878
North Dakota	20,090	5,395			20,090	5,395
Ohio	[1] 6,917,110	[1] 5,693,137	476,950	348,469	[1] 7,394,060	[1] 6,041,606
Oklahoma	817,410	783,493	125,090	70,770	942,500	854,263
Oregon	1,701,640	1,269,781			1,701,640	1,269,781
Pennsylvania	7,505,720	7,129,840	279,950	263,629	7,785,670	7,393,469
Puerto Rico	225,990	238,426	13,620	9,470	239,610	247,896
Rhode Island	[1] 185,220	[1] 276,370			[1] 185,220	[1] 276,370
South Carolina	[1] 510,160	[1] 705,983	427,330	423,983	[1] 937,490	[1] 1,129,966
South Dakota	[1] 187,490	[1] 182,541			[1] 187,490	[1] 182,541
Tennessee	1,791,390	1,638,074	385,430	305,106	2,176,820	1,943,180
Texas	[1] 2,774,720	[1] 1,934,473	225,530	101,319	[1] 3,000,250	[1] 2,035,792
Utah	623,260	298,200	(2)	(2)	[1] 623,260	[1] 298,200
Vermont	189,680	205,369			189,680	205,369
Virginia	[1] 3,634,050	[1] 3,342,621	[1] 406,600	[1] 291,270	4,379,600	3,961,559
Washington	[1] 1,780,560	[1] 1,329,929			[1] 1,780,560	[1] 1,329,929
West Virginia	[1] 2,042,020	[1] 3,376,708	117,070	73,072	[1] 2,159,090	[1] 3,449,780
Wisconsin	2,488,170	2,086,129	(2)	(2)	[1] 2,488,170	[1] 2,086,129
Wyoming	89,350	100,453	(2)	(2)	[1] 89,350	[1] 100,453
Undistributed	1,501,550	1,657,102	491,940	392,637	1,258,040	1,234,462
	88,787,080	84,212,446	5,975,970	4,554,775	94,763,050	88,767,221

[1] To avoid disclosing confidential information certain totals are somewhat incomplete, the figures not included being combined under "Undistributed."
[2] Included 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 32 percent in 1938 compared with 1937, while commercial production decreased 3 percent.

Concrete and road metal and railroad ballast sold or used by commercial and noncommercial operators in the United States, 1934–38

[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 operation				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
1934	43, 259, 180	$0. 94	+14. 3	71. 4	17, 308, 740	$0. 91	+126. 2	28. 6	60, 567, 920	+33. 1
1935	38, 090, 660	. 90	−11. 9	69. 6	16, 663, 860	. 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

Methods of transportation.—The following table shows the quantities of concrete and road metal conveyed by each of the principal means of transportation during 1938.

Concrete and road metal shipped by commercial and noncommercial operators in the United States in 1938, by methods of transportation [1]

Method of transportation	Commercial operations		Noncommercial operations		Total	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Railroad	12, 032, 490	22. 2			12, 032, 490	13. 5
Water	5, 398, 770	9. 9			5, 398, 770	6. 1
Truck	32, 779, 040	60. 4	34, 508, 880	100. 0	67, 287, 920	75. 8
Unspecified	4, 067, 900	7. 5			4, 067, 900	4. 6
Total:						
Quantity	54, 278, 200	100. 0	34, 508, 880	100. 0	88, 787, 080	100. 0
Value	$48, 427, 045		$35, 785, 401		$84, 212, 446	

[1] Exclusive of railroad ballast, virtually all of which is shipped by rail.

GRANITE

Sales of crushed granite increased 15 percent in quantity and 27 percent in value in 1938 compared with 1937. That used for concrete aggregate and road construction made only a small gain, but sales of both railroad ballast and riprap were far in advance of 1937 and the unit values of these products were much higher. The price of ballast per ton at the quarry increased from 65 cents to 88 cents and that of riprap from $1.07 to $1.44. A large part of the riprap production was noncommercial.

Granite (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	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)	(1)
Arizona	4	(1)	(1)	(1)	(1)	(1)	(1)			30,380	$15,035
California	20	394,220	$359,516	364,340	$240,400	(1)	(1)	(1)	(1)	1,088,720	735,948
Colorado	15			161,940	164,677					161,940	164,677
Connecticut	3	(1)	(1)					(1)	(1)	11,160	27,483
Delaware	2	(1)	(1)	(1)	(1)					(1)	(1)
Georgia	34	22,470	21,340	879,720	948,277	(1)	(1)	(1)	(1)	965,070	1,012,662
Idaho	4			(1)	(1)					(1)	(1)
Maine	7	(1)	(1)	(1)	(1)					58,880	80,858
Maryland	6	29,080	37,252	38,130	53,718			120	$162	67,330	91,132
Massachusetts	14	(1)	(1)	309,810	375,957	(1)	(1)	(1)	(1)	344,410	420,527
Minnesota	13	(1)	(1)	25,430	37,001			(1)	(1)	31,460	44,660
Missouri	2	2,700	1,814							2,700	1,814
Montana	3	596,890	1,214,337	18,340	7,501					615,230	1,221,838
New Hampshire	10	4,350	2,993	25,340	32,188					29,690	35,181
New Jersey	2			(1)	(1)	(1)	(1)			(1)	(1)
New York	24	239,550	239,549	539,660	555,192	9,200	$7,080			788,410	801,821
North Carolina	90	690	509	2,550,240	3,191,033	623,860	668,860	5,380	31,835	3,180,170	3,892,237
Oklahoma	3	(1)	(1)	(1)	(1)					4,500	3,450
Pennsylvania	9	330	136	160,090	196,445			2,270	3,810	162,690	200,391
Rhode Island	6	(1)	(1)	(1)	(1)					67,360	113,923
South Carolina	6	8,670	10,465	507,830	703,653	427,330	423,983	28,930	10,435	972,760	1,148,536
South Dakota	40	(1)	(1)	(1)	(1)					22,360	47,832
Tennessee	3			50,020	54,071					50,020	54,071
Texas	1	(1)	(1)							(1)	(1)
Utah	1			(1)	(1)			(1)	(1)	(1)	(1)
Vermont	1			(1)	(1)					(1)	(1)
Virginia	8	(1)	(1)	519,630	503,623	(1)	(1)			656,680	609,623
Washington	5	(1)	(1)	89,500	95,484			(1)	(1)	104,510	107,649
Wisconsin	11	2,470	3,000	6,260	9,122			2,010	9,246	10,740	21,368
Undistributed		67,260	79,452	388,990	463,565	568,550	332,960	88,750	46,936	333,180	284,861
	348	1,368,680	1,970,363	6,635,270	7,631,907	1,628,940	1,432,883	127,460	102,424	9,760,350	11,137,577

[1] Included under "Undistributed."

BASALT

Basalt, gabbro, diorite, and other dark igneous rocks, known commercially as trap rock, are used widely for road building because of their toughness and excellent wearing qualities. Sales for this use and for concrete aggregate were about the same in 1938 as in 1937, but the output of riprap was nearly 2½ times as great as in 1937. The increase was general and consisted chiefly of the output of commercial companies. The larger output of New England was due to demands for stone to remedy the ravages of the hurricane. Prices of aggregates and road stone at the quarry were 4 cents a ton lower in 1938 than in 1937, and those of riprap were 5 cents lower.

Basalt and related rocks (trap rock) (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	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
California	11	290,160	$279,097	428,480	$442,921	(1)	(1)	(1)	(1)	781,310	$770,941
Colorado	4	27,720	28,556	116,100	106,586	-----	-----	-----	-----	143,820	135,142
Connecticut	17	25,510	19,386	1,259,110	1,197,857	168,850	$143,454	-----	-----	1,453,470	1,360,697
Hawaii	14	9,050	2,075	467,160	685,408	(1)	(1)	(1)	(1)	476,230	687,531
Idaho	27	(1)	(1)	922,810	720,858	(1)	(1)	-----	-----	924,630	721,525
Maine	3	-----	-----	14,390	10,548	-----	-----	-----	-----	14,390	10,548
Maryland	5	(1)	(1)	(1)	(1)	-----	-----	-----	-----	78,830	101,292
Massachusetts	17	177,670	70,904	1,072,750	942,399	102,040	89,440	-----	-----	1,352,460	1,102,743
Michigan	6	-----	-----	(1)	(1)	-----	-----	(1)	(1)	129,850	135,769
Minnesota	1	-----	-----	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)
Montana	14	21,220	13,432	443,080	284,319	-----	-----	-----	-----	464,300	297,751
Nevada	1	-----	-----	(1)	(1)	-----	-----	-----	-----	(1)	(1)
New Jersey	23	2,370	2,833	2,205,030	2,055,826	52,460	53,456	-----	-----	2,259,860	2,112,115
New York	3	-----	-----	(1)	(1)	(1)	(1)	-----	-----	925,690	1,000,471
North Carolina	6	-----	-----	58,700	54,603	-----	-----	-----	-----	58,700	54,603
Oregon	122	322,730	350,398	1,586,530	1,194,261	-----	-----	8,080	$5,388	1,917,340	1,550,047
Pennsylvania	9	(1)	(1)	598,850	545,075	72,990	68,577	(1)	(1)	674,150	618,049
Texas	1	-----	-----	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)
Virginia	6	-----	-----	212,910	187,491	-----	-----	-----	-----	212,910	187,491
Washington	90	367,330	216,567	1,553,850	1,062,930	-----	-----	-----	-----	1,921,180	1,279,497
Wisconsin	2	-----	-----	(1)	(1)	-----	-----	-----	-----	(1)	(1)
Undistributed	-----	4,750	3,885	1,149,870	1,286,738	132,470	123,559	11,920	9,638	97,820	132,253
	382	1,248,510	987,133	12,089,620	10,777,820	528,810	478,486	20,000	15,026	13,886,940	12,258,465

[1] Included under "Undistributed."

MARBLE

Marble may be used for virtually the same purposes as crushed limestone, and producers of building and monumental marble find outlets for waste stone in the form of crushed and pulverized products.

Marble (crushed and broken stone) sold by producers in the United States in 1938, by States [1]

State	Active plants	Short tons	Value	State	Active plants	Short tons	Value
Alabama	3	27,250	$44,900	Tennessee	4	50,590	$37,178
Arkansas	1	480	2,415	Vermont	2	820	5,844
Georgia	1	10,490	20,970	Undistributed [2]	12	24,280	120,601
Maryland	1	2,190	24,269				
Massachusetts	1	2,510	1,704		26	130,390	275,225
Missouri	1	11,780	17,344				

[1] Includes stone used for artificial stone, crushed stone, flux, riprap, stucco, terrazzo, whiting substitute, and uses not specified.
[2] Arizona, California, New York, Virginia, and Washington.

LIMESTONE

Limestone comprised 66 percent of all crushed and broken stone sold in 1938 (excluding that used for making cement and lime). It is employed more extensively than other rocks because it is widely distributed and therefore available to a multitude of markets and because it can be quarried and crushed at moderate cost. Furthermore, limestone is essential to many commodities and to a host of chemical and manufacturing processes. The following tables show production by States and uses during 1938 and sales for miscellaneous industrial uses.

Limestone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	Riprap		Fluxing stone		Crushed stone: Concrete and road metal		Crushed stone: Railroad ballast		Agriculture		Other uses		Total	
		Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	38	(1)	(1)	690,600	$494,247	325,000	$349,826	-----	-----	(1)	(1)	(1)	(1)	1,123,650	$965,251
Arizona	8	(1)	(1)	(1)	(1)	29,000	37,222	-----	-----	-----	-----	-----	-----	58,170	57,080
Arkansas	16	(1)	(1)	(1)	(1)	59,940	49,567	(1)	(1)	12,520	$21,712	(1)	(1)	114,070	128,241
California	22	471,320	$942,441	23,230	34,314	62,340	38,095	-----	-----	510	1,398	209,490	$515,803	766,890	1,532,051
Colorado	11	-----	-----	(1)	(1)	(1)	(1)	-----	-----	-----	-----	52,080	88,012	252,230	232,905
Connecticut	4	-----	-----	(1)	(1)	(1)	(1)	-----	-----	32,100	117,100	14,070	52,814	48,080	173,040
Florida	33	7,020	7,050	-----	-----	1,104,720	908,426	(1)	(1)	35,110	75,194	(1)	(1)	1,303,320	1,040,864
Georgia	20	-----	-----	(1)	(1)	284,850	294,246	-----	-----	(1)	(1)	66,770	163,651	356,710	467,371
Hawaii	1	-----	-----	-----	-----	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)
Idaho	5	(1)	(1)	(1)	(1)	(1)	(1)	-----	-----	-----	-----	(1)	(1)	27,670	30,674
Illinois	245	103,100	106,185	141,780	116,581	6,729,280	5,584,382	220,130	$153,755	1,095,640	1,003,385	152,560	290,829	8,442,490	7,255,117
Indiana	192	30,260	19,659	23,640	16,475	2,833,300	2,634,453	76,070	59,440	352,390	367,204	119,340	115,112	3,435,000	3,212,343
Iowa	226	182,180	113,089	(1)	(1)	2,853,530	3,313,028	(1)	(1)	236,300	207,883	40,570	97,976	3,320,510	3,739,573
Kansas	212	283,140	199,994	-----	-----	2,998,950	4,271,228	126,790	109,509	16,760	19,750	3,220	7,105	3,428,860	4,607,586
Kentucky	130	35,630	32,316	-----	-----	2,631,670	2,442,900	343,660	169,042	321,130	301,546	9,830	14,431	3,341,920	2,960,235
Louisiana	1	-----	-----	-----	-----	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)
Maine	3	-----	-----	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	36,280	95,383
Maryland	16	(1)	(1)	-----	-----	532,850	520,396	(1)	(1)	3,610	9,229	(1)	(1)	558,890	553,760
Massachusetts	9	-----	-----	(1)	(1)	-----	-----	-----	-----	75,960	272,728	(1)	(1)	97,210	332,383
Michigan	25	39,420	10,883	2,584,220	1,223,819	2,091,260	1,002,438	64,640	39,173	108,130	71,454	2,635,160	1,278,706	7,522,830	3,626,473
Minnesota	83	38,240	47,861	(1)	(1)	744,870	726,953	(1)	(1)	25,230	29,203	(1)	(1)	817,460	832,585
Missouri	280	659,710	837,079	32,210	35,169	2,217,690	2,611,962	66,410	61,213	150,920	162,430	125,910	233,852	3,252,850	3,941,705
Montana	7	-----	-----	(1)	(1)	29,880	10,101	(1)	(1)	-----	-----	44,300	58,101	124,150	104,557
Nebraska	24	118,900	214,961	(1)	(1)	369,510	470,925	-----	-----	550	1,437	(1)	(1)	510,240	780,664
Nevada	3	-----	-----	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	55,720	72,579
New Jersey	4	-----	-----	(1)	(1)	(1)	(1)	-----	-----	(1)	(1)	(1)	(1)	162,370	388,011
New Mexico	6	2,240	570	-----	-----	263,710	196,245	-----	-----	-----	-----	-----	-----	265,950	196,815
New York	152	219,140	257,372	11,690	12,120	6,023,300	6,226,976	435,070	304,328	167,290	392,093	956,800	703,677	7,813,290	7,896,566
North Carolina	4	-----	-----	-----	-----	70,710	71,796	-----	-----	11,840	13,024	-----	-----	82,550	84,820
Ohio	184	136,950	106,112	1,600,490	1,034,367	6,651,950	5,481,289	476,950	348,469	346,870	421,333	274,740	422,152	9,487,950	7,813,722
Oklahoma	56	(1)	(1)	-----	-----	788,750	754,669	(1)	(1)	30,520	59,999	68,290	105,833	1,010,060	1,002,776
Oregon	5	-----	-----	-----	-----	(1)	(1)	-----	-----	15,410	42,889	(1)	(1)	29,720	70,909
Pennsylvania	182	8,560	7,040	3,247,110	2,899,018	4,103,760	4,256,604	111,530	105,196	312,010	760,078	347,870	854,165	8,130,840	8,882,101
Puerto Rico	34	-----	-----	-----	-----	(1)	(1)	(1)	(1)	-----	-----	-----	-----	150,910	168,042
Rhode Island	1	-----	-----	(1)	(1)	-----	-----	-----	-----	(1)	(1)	(1)	(1)	(1)	(1)
South Carolina	2	-----	-----	-----	-----	(1)	(1)	-----	-----	(1)	(1)	-----	-----	(1)	(1)

South Dakota	19	16, 730	32, 863	----	----	61, 600	54, 958	----	----	----	----	5, 850	5, 850	84, 180	93, 671
Tennessee	129	3, 750	4, 060	13, 180	13, 241	1, 683, 670	1, 529, 796	385, 430	305, 106	287, 860	297, 845	31, 170	95, 545	2, 405, 060	2, 245, 593
Texas	65	26, 230	22, 562	38, 690	28, 672	1, 709, 770	1, 163, 215	171, 840	67, 366	100	350	124, 380	128, 992	2, 071, 010	1, 411, 157
Utah	13	----	----	(1)	(1)	126, 050	66, 981	----	----	----	----	(1)	(1)	245, 420	161, 098
Vermont	14	----	----	----	----	(1)	(1)	----	----	(1)	(1)	(1)	(1)	48, 950	91, 812
Virginia	126	52, 720	27, 327	234, 400	220, 004	2, 699, 480	2, 433, 910	383, 660	276, 947	319, 470	387, 429	456, 620	400, 394	4, 146, 350	3, 746, 011
Washington	7	----	----	(1)	(1)	137, 210	171, 515	----	----	(1)	(1)	66, 210	144, 918	250, 110	377, 286
West Virginia	102	13, 840	10, 651	691, 160	564, 176	1, 136, 110	2, 076, 955	117, 070	73, 072	77, 580	134, 361	175, 340	171, 607	2, 211, 100	3, 030, 822
Wisconsin	153	88, 170	71, 246	27, 410	18, 114	2, 325, 850	1, 916, 185	(1)	(1)	135, 690	141, 121	(1)	(1)	2, 626, 860	2, 240, 367
Wyoming	7	(1)	(1)	(1)	(1)	87, 920	99, 015	(1)	(1)	----	----	(1)	(1)	249, 240	331, 886
Undistributed	----	53, 520	36, 190	332, 320	223, 304	588, 650	621, 119	208, 520	138, 265	195, 910	325, 310	799, 830	1, 123, 479	508, 490	373, 993
	2, 879	2, 590, 770	3, 107, 511	9, 692, 130	6, 933, 621	54, 357, 130	52, 387, 376	3, 187, 770	2, 210, 881	4, 367, 410	5, 637, 485	6, 780, 400	7, 073, 004	80, 975, 610	77, 349, 878

[1] Included under "Undistributed."

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Limestone sold or used by producers in the United States for miscellaneous uses, 1937–38

Use	1937		1938	
	Short tons	Value	Short tons	Value
Alkali works	4,860,520	$2,295,599	3,634,050	$1,743,173
Calcium carbide works	472,240	266,557	246,010	137,522
Coal-mine dusting	64,610	227,061	50,890	178,263
Filler (not whiting substitute):				
Asphalt	351,590	686,951	288,590	789,587
Fertilizer	74,400	174,218	121,130	202,189
Other	20,890	38,726	61,970	245,356
Filter beds	34,970	34,250	142,050	127,586
Glass factories	274,770	460,352	170,560	290,297
Limestone sand			229,890	180,863
Magnesia works (dolomite)	96,730	158,023	62,540	99,684
Mineral food	67,230	238,847	65,570	226,844
Mineral (rock) wool	146,330	116,084	86,400	85,378
Paper mills	322,810	589,091	223,450	373,207
Poultry grit	27,360	118,343	31,260	153,789
Refractory (dead-burned dolomite)	576,900	580,720	263,930	274,624
Road base	206,060	106,931	205,840	117,882
Stucco, terrazzo, and artificial stone	36,180	152,788	23,360	146,828
Sugar factories	566,620	862,660	619,910	878,028
Whiting substitute [1]	194,080	923,494	145,170	671,842
Other uses [2]	173,000	328,768	80,350	89,447
Use unspecified	68,780	64,875	27,480	60,615
	8,636,070	8,424,338	6,780,400	7,073,004

[1] Includes stone for filler for graphite, calcimine, linoleum, paint, pigments, pottery, putty, regrinding, rubber, sealing wax, soap, tile, and uses not specified.
[2] Includes stone for acetic acid, acid neutralization, bird gravel, carbon dioxide, cement blocks, chemicals (unspecified), concrete blocks and pipes, dye works, explosives, fill, fireplace stone, foundry facings, lime burning, roofing gravel, sand, spalls, and waste rock.

Certain special uses of dolomite (calcium-magnesium carbonate) and its primary product of calcination, dolomitic lime, are covered in the following table:

Dolomite and dolomitic lime sold or used by producers in the United States for specified purposes, 1937–38

	1937	1938
Dolomite for—		
Basic magnesium carbonate:		
Short tons	96,730	62,540
Value	$158,023	$99,684
Carbon dioxide	(1)	(1)
Dead-burned dolomite or refractory stone:		
Short tons	576,900	263,930
Value	$580,720	$274,624
Dolomitic lime for—		
Refractory (dead-burned dolomite):		
Short tons	617,706	366,626
Value	$5,217,833	$3,095,355
Sulfite pulp:		
Short tons	43,000	39,000
Value	$293,000	$274,000
Total (calculated as raw stone) short tons	1,995,000	1,168,000

[1] Data not available.

Limestone is quarried not only for use in the raw state 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 used for all purposes in the United States, 1936–38, in short tons

Use	1936	1937	1938
Limestone (as given in this report) (approximate)	87,736,000	94,577,000	81,514,000
Portland cement (including "cement rock") [1] Natural cement ("cement rock") [1]	28,650,000	29,547,000	26,183,000
Lime [2]	7,500,000	8,250,000	6,694,000
	123,886,000	132,374,000	114,391,000

[1] Value reported as cement in the chapter on Cement.
[2] Value reported as lime in the chapter on Lime.

SANDSTONE

The sandstone industry, which suffered a serious set-back in 1937, recovered remarkably in 1938. Sales increased 27 percent in quantity and 14 percent in value. Because of reduced activity in steel plants sales of refractory stone (ganister) declined greatly, but the output of riprap and stone for highway use and concrete aggregate made large gains.

Sandstone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	Refractory stone (ganister)		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	Short tons	Value
Alabama	10	(1)	(1)			(1)	(1)					114,690	$100,396
Arizona	1			(1)	(1)							(1)	(1)
Arkansas	9					193,510	$151,553					193,510	151,553
California	19	(1)	(1)	49,240	$34,463	476,170	413,280	(1)	(1)	(1)	(1)	699,460	577,093
Colorado	20	4,790	$7,492	4,730	2,134	123,380	135,172					132,900	144,798
Georgia	1					(1)	(1)					(1)	(1)
Idaho	1					(1)	(1)					(1)	(1)
Illinois	2	(1)	(1)			(1)	(1)					(1)	(1)
Indiana	8					26,080	24,831					26,080	24,831
Iowa	1					(1)	(1)					(1)	(1)
Kansas	20			1,250	1,000	162,850	221,646					164,100	222,646
Kentucky	1	(1)	(1)									(1)	(1)
Maryland	1					(1)	(1)					(1)	(1)
Michigan	3					31,490	31,867					31,490	31,867
Minnesota	2			(1)	(1)	(1)	(1)					(1)	(1)
Montana	2	(1)	(1)	(1)	(1)							(1)	(1)
New Mexico	1							(1)	(1)			(1)	(1)
New York	33	(1)	(1)	15,530	5,272	236,840	217,181			(1)	(1)	257,500	229,303
North Carolina	3					605,720	748,895					605,720	748,895
Ohio	27	17,060	101,864	50,030	67,196	265,160	211,848			240	$611	332,490	381,519
Oklahoma	7					10,290	14,774					10,290	14,774
Oregon	6			(1)	(1)	(1)	(1)					283,190	308,586
Pennsylvania	47	187,770	283,855	35,890	40,589	482,620	525,916	95,430	$89,856	10,670	14,010	812,380	954,226
South Dakota	6			(1)	(1)	58,030	77,294			(1)	(1)	132,540	136,863
Tennessee	2					36,060	37,459					36,060	37,459
Texas	8			(1)	(1)	89,090	59,243	(1)	(1)			114,360	77,456
Utah	7	7,010	14,016			416,540	192,711					423,550	206,727
Vermont	17					28,920	26,389					28,920	26,389
Virginia	25					202,030	217,597	22,940	14,323	9,590	3,350	234,560	235,270
Washington	1			650	460					250	768	900	1,228
West Virginia	139	(1)	(1)	(1)	(1)	905,910	1,299,753					983,880	1,360,741
Wisconsin	9	67,790	97,186	8,650	8,650	1,470	3,159			133,830	334,131	211,740	443,126
Wyoming	1					(1)	(1)					(1)	(1)
Undistributed		96,690	100,697	431,080	384,674	278,630	179,327	96,090	81,468	170,320	114,563	318,000	176,777
	440	381,110	605,110	597,050	544,438	4,630,790	4,789,895	214,460	185,647	324,900	467,433	6,148,310	6,592,523

[1] Included under "Undistributed."

MISCELLANEOUS STONE

Stone other than the five principal varieties already discussed includes light-colored volcanic rocks, schists, boulders from river beds, serpentine, and flint. The following table shows production of such types of stone by uses in 1938.

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses

State	Active plants	Riprap		Crushed stone				Other uses		Total	
		Short tons	Value	Concrete and road metal		Railroad ballast		Short tons	Value	Short tons	Value
				Short tons	Value	Short tons	Value				
Alabama	2			(1)	(1)					(1)	(1)
Alaska	10			125,310	$143,571					125,310	$143,571
Arizona	11			336,070	241,353					336,070	241,353
Arkansas	2	(1)	(1)	(1)	(1)	(1)	(1)			(1)	(1)
California	83	133,610	$151,340	3,956,190	2,653,960	148,210	$62,420	9,570	$49,998	4,247,580	2,917,718
Colorado	8	100	200	198,760	150,398					198,860	150,598
Florida	3			31,060	68,520					31,060	68,520
Georgia	13			13,290	19,711					13,290	19,711
Hawaii	2			(1)	(1)					(1)	(1)
Idaho	2			(1)	(1)					(1)	(1)
Illinois	1			38,590	16,013					38,590	16,013
Indiana	4			17,380	18,401					17,380	18,401
Iowa	1			(1)	(1)					(1)	(1)
Kansas	3	(1)	(1)	(1)	(1)					20,450	32,260
Maine	5			23,280	43,282					23,280	43,282
Maryland	4	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	127,680	132,705
Massachusetts	4	(1)	(1)	(1)	(1)					275,770	375,915
Michigan	9	113,900	113,639	95,570	98,941			6,730	52,901	216,200	265,481
Minnesota	2			(1)	(1)					(1)	(1)
Missouri	4	(1)	(1)	(1)	(1)			(1)	(1)	13,430	19,349
Montana	4			75,890	51,045					75,890	51,045
Nevada	8	54,370	31,412	31,390	54,726			196,130	81,938	281,890	168,076
New Hampshire	2			1,750	2,748			3,260	23,786	5,010	26,534
New Jersey	4			(1)	(1)			(1)	(1)	87,700	91,823
New Mexico	7			432,400	241,469					432,400	241,469
New York	5			(1)	(1)			(1)	(1)	215,730	134,411
North Carolina	35			593,720	536,691					593,720	536,691
North Dakota	8			20,090	5,395					20,090	5,395
Ohio	2			(1)	(1)			(1)	(1)	(1)	(1)
Oklahoma	7	(1)	(1)	(1)	(1)	(1)	(1)			70,330	38,853
Oregon	6	(1)	(1)	(1)	(1)					124,430	92,125
Pennsylvania	73	5,900	5,310	2,160,400	1,605,800			38,670	288,938	2,204,970	1,900,048

[1] Included under "Undistributed."

Miscellaneous varieties of stone (crushed and broken stone) sold or used by producers in the United States in 1938, by States and uses—Continued

State	Active plants	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
Puerto Rico	9			([1])	([1])	([1])	([1])			88,700	$79,854
Rhode Island	6			185,220	$276,370					185,220	276,370
South Carolina	4			2,330	2,330					2,330	2,330
South Dakota	21	310	$310	67,860	50,289					68,170	50,599
Tennessee	5			21,640	16,748					21,640	16,748
Texas	14	([1])	([1])	975,860	712,015	([1])	([1])	([1])	([1])	1,016,470	741,189
Utah	5			([1])	([1])			([1])	([1])	40,460	22,424
Vermont	30			113,040	104,663					113,040	104,663
Virginia	17			([1])	([1])			([1])	([1])	206,210	294,355
Washington	5			([1])	([1])			([1])	([1])	43,730	38,727
West Virginia	2			([1])	([1])					([1])	([1])
Wisconsin	11	([1])	([1])	([1])	([1])					96,770	73,910
Wyoming	2			([1])	([1])					([1])	([1])
Undistributed		97,320	83,762	1,557,180	1,511,009	267,780	$184,458	21,090	$107,356	491,370	430,700
	465	405,510	385,973	11,074,270	8,625,448	415,990	246,878	275,450	604,917	12,171,220	9,863,216

[1] Included under "Undistributed."

MARKETS

The consumption of concrete aggregates and roadstone ordinarily bears a fairly definite relationship to portland-cement shipments, area of new concrete pavements, and total building construction; but, as shown graphically in figure 3, aggregates made a much better showing in 1938 than the others. The commercial producer was not as fortunate as the chart would indicate, because the gain was in

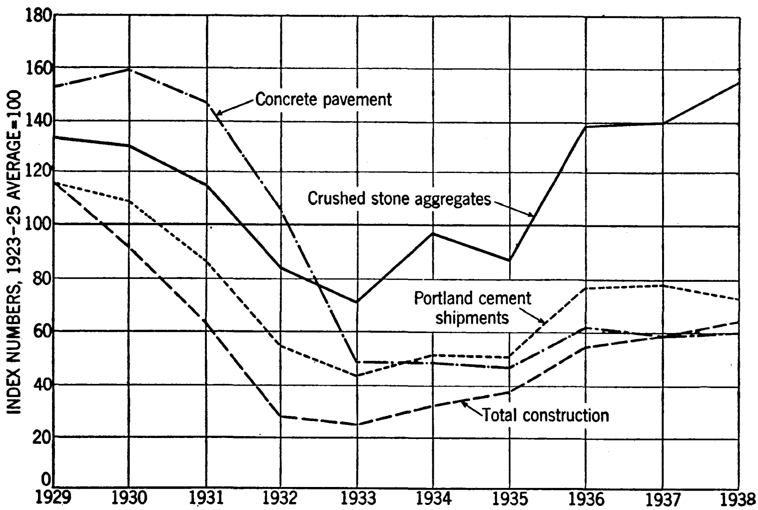

FIGURE 3.—Sales of crushed-stone aggregates (tons) compared with total construction, portland-cement shipments, and contracts for concrete pavements 1929–38. Data are plotted as index numbers with the 1923–25 average as 100. Figures on concrete pavements compiled by Portland Cement Association and on construction contracts by F. W. Dodge Corporation.

noncommercial production. Commercial production declined 3 percent in 1938, whereas noncommercial production increased 32 percent. The most logical explanation for the disproportionate increase in production of aggregates seems to be the fact that a large part of the stone produced at noncommercial quarries is employed on secondary roads and in other ways that have little connection with the other elements in figure 3.

Limestone is used extensively as a flux in blast furnaces producing pig iron and to a smaller extent in certain other smelting operations. Therefore a close relationship is to be expected between production of pig iron and sales of fluxing stone. Figure 4 shows the remarkable parallelism between these two industrial activities.

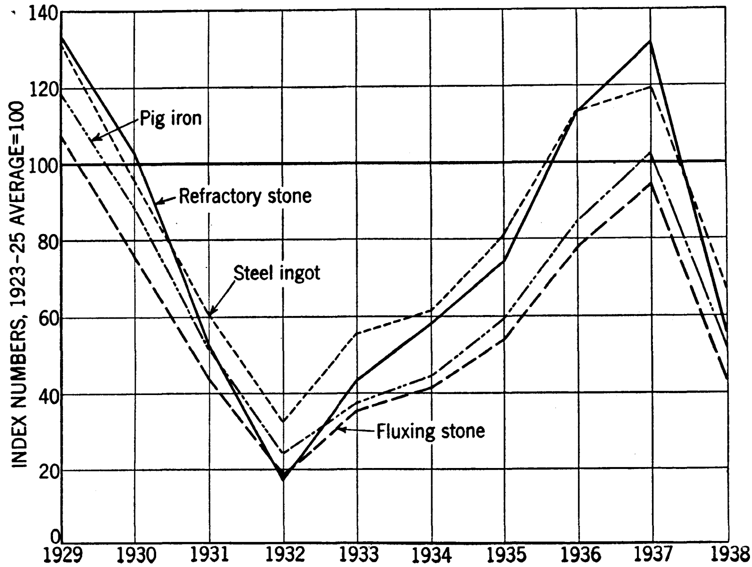

FIGURE 4.—Sales of fluxing stone and refractory stone (tons) compared with production of steel ingot and pig iron, 1929-38. All data are plotted as index numbers, with the 1923-25 average as 100. Statistics of steel-ingot and pig-iron production compiled by American Iron and Steel Institute.

Large quantities of dolomite and ganister are used as refractories in steel furnaces. Consumption of these products therefore fluctuates more or less in consonance with the changing pace of steel ingot production. Furnace relining is more active in some years than others, therefore the curves for steel ingot and refractory stone agree less closely than those for pig iron and fluxing stone.

NEW DEVELOPMENTS

Plants.—The current trend toward the use of smaller stone in concrete mixtures has led to the installation of additional crushers and supplementary equipment at many crushed-stone plants. New grinding and screening equipment has been added at several plants to provide for a growing market for agricultural limestone.

A record of new crushing plants and remodeling of existing plants during 1938 may be found in the technical press.[3]

Products.—Stone sand is being used more widely as a substitute for silica sand as fine aggregate in concrete. Success in marketing this product can be expected principally where natural sand is not readily available. The grains must have proper shape and proper gradation; cubic or rounded particles are better than flat grains, and a lean concrete requires finer sand than a rich concrete. Stone sand is becoming an important byproduct at several limestone, dolomite, and granite quarries.

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[3] Pit and Quarry, The Crushed-stone Industry in 1938: Vol. 31, Jan. 1939, pp. 91–97.

FOREIGN TRADE [4]

Imports.—Foreign trade in stone is confined chiefly to dimension stone, but imports of quartzite from Canada are becoming increasingly important. Total imports in 1938 decreased 15 percent in value from 1937. The following table shows the quantities and values imported in 1938, by kinds. Imports of marble and rough granite declined greatly, but imports of dressed granite and miscellaneous stone products rose substantially, and those of travertine more than doubled. As indicated in the table of imports by countries of origin, imports of onyx marble from Mexico were smaller in 1938 than in 1937, while those from Argentina were larger in quantity but much smaller in value.

Stone imported for consumption in the United States in 1938, by classes

Class	Quantity	Value
Marble, breccia, and onyx:		
In blocks, rough, etc. cubic feet	54,582	$197,284
Sawed do	170	873
Slabs or paving tiles superficial feet	177,125	55,585
All other manufactures	--------	47,215
Mosaic cubes of marble or onyx: Loose pounds	39,478	714
	--------	301,671
Granite:		
Dressed cubic feet	40,891	200,243
Rough do	30,523	49,330
	71,414	249,573
Quartzite short tons	109,403	$224,738
Travertine stone: Rough cubic feet	29,641	32,313
Stone (other):		
Dressed	--------	1,510
Rough (monumental or building stone) cubic feet	3,000	6,831
Rough (other) short tons	9,684	21,882
	--------	30,223
Grand total	--------	838,518

[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.

Stone imported for consumption in the United States in 1938, by classes and countries

Country	Marble, breccia, and onyx			Granite		Other building or monumental stone (value)	Other stone, n. e. s. (value)	Quartzite		Travertine		Total value
	Rough		Manufactures (value)	Cubic feet	Value			Short tons	Value	Cubic feet	Value	
	Cubic feet	Value										
North America:												
Canada	231	$1,374	$130	2,919	$3,482	$240	$15,099	109,061	$199,864			$220,189
Cuba	26	13	865			9						887
Mexico	10,443	43,940	327									44,267
Total North America	10,700	45,327	1,322	2,919	3,482	249	15,099	109,061	199,864			265,343
South America:												
Argentina	3,558	56,030	401									56,431
Brazil	9	60										60
Other South America	61	850	27									877
Total South America	3,628	56,940	428									57,368
Europe:												
Belgium	9,665	24,464	16,548									41,012
Czechoslovakia				202	1,765							1,765
Finland			30	55,116	214,365							214,395
France	3,830	8,999	10,047			788						19,834
Germany			496	16	189							685
Italy	24,275	53,862	62,822	10	99	1,004				29,641	$32,313	150,100
Sweden	374	1,697		12,178	26,490			29	669			28,856
United Kingdom	316	1,689	2,487	223	1,156	367	6,773					12,472
Other Europe	1,770	4,103	1,230	699	1,767	285		303	24,129			31,514
Total Europe	40,230	94,814	93,660	68,444	245,831	2,444	6,773	332	24,798	29,641	32,313	500,633
Asia:												
China			582			204						786
India, British	10	106	8,264			10						8,380
Other Asia			131	51	260	226	10	10	76			703
Total Asia	10	106	8,977	51	260	440	10	10	76			9,869
Africa	14	97				5,208						5,305
Grand total	54,582	197,284	104,387	71,414	249,573	8,341	21,882	109,403	224,738	29,641	32,313	838,518

Exports.—The export trade in stone is relatively small, and most of it is with Canada. The following table of exports appears in a new form because the export classification has been changed to combine marble with other building and monumental stone.

Stone exported from the United States in 1938, by countries

Country	Marble and other building and monumental stone		Other manufactures of stone (value)
	Cubic feet	Value	
Canada	72,398	$111,644	$145,003
Cuba	1,438	6,083	19,224
Germany	455	830	10,643
Mexico	1	53	17,398
Netherland India	------	------	12,952
Newfoundland and Labrador	1,122	6,350	507
United Kingdom	778	$1,891	$11,967
Other countries	2,182	14,964	64,728
	78,374	141,815	282,422

SLATE

By Oliver Bowles and M. Schauble

SUMMARY OUTLINE

From the low point of the depression in 1933 the slate industry made steady gains until 1938 but suffered a severe setback in that year. The quantity of slate sold as dimension stone in 1938 dropped 14 percent and the value 21 percent compared with 1937. The substantial drop in prices per unit is noteworthy. If the reduced price is a measure of lower costs of production it may imply a more favorable competitive position for slate, but if it represents reduction of inventories and price cutting to levels approaching or lower than cost of production—a condition that has obtained in the slate industry repeatedly—one must infer that 1938 was in general an unprofitable year.

Roofing-slate sales declined relatively more in value than in quantity. The average value per square in 1938 was $6.98, whereas in 1937 it was $7.46. Sales in the Pennsylvania district dropped 11 percent in quantity and 17 percent in value compared with 1937. In the New York-Vermont district the quantity sold dropped 20 percent and the value 28 percent. In Virginia, however, sales increased 5 percent in quantity and 6 percent in value. The more favorable condition of the Virginia industry probably was due to the active residential building that characterized Washington, D. C., and its vicinity during 1938.

Sales of millstock declined 15 percent in quantity and 30 percent in value compared with 1937. Although building construction advanced from 59 percent of the 1923–25 average in 1937 to 64 percent in 1938, sales of structural and sanitary slate dropped 14 percent in quantity and 24 percent in value. Evidently slate is being replaced by other structural materials. The greatest decline experienced by any major branch of the slate industry was that of electrical slate, which dropped 63 percent in both quantity and value. Although high-grade slate is regarded as of superior quality for electrical panels and switchboards, it is apparent that various synthetic dielectric materials are being used to an increasing extent. Blackboards and bulletin boards maintained their position very well, for sales were off only 1 percent in quantity and 3 percent in value. Billiard-table tops, which represent a relatively unimportant branch of the industry, made large gains in 1938. Sales of school slates decreased in quantity but gained in value. Sales of slate for vaults and covers and for flagging, cross walks, and stepping stones slumped greatly. Granules and flour, which have little connection with the slate industry, appear in the table because they are manufactured from slate, although much of the material so used is derived from deposits that could not be utilized for dimension-slate products. Granule sales made large gains in 1938, and the value per ton was $1.43 higher than in 1937.

The following table giving the principal statistical data for the slate industry during 1937 and 1938 is arranged to permit ready comparison for the 2 years:

Salient statistics of the slate industry in the United States, 1937–38

	1937			1938				
	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* 365, 800	137, 400	$2, 728, 109	*Squares* 322, 040	119, 590	$2, 247, 910	−12. 0	−17. 6
Millstock:	*Sq. ft.*			*Sq. ft.*				
Electrical slate	594, 660	5, 140	444, 887	221, 140	1, 830	162, 793	−62. 8	−63. 4
Structural and sanitary slate	997, 860	8, 080	322, 974	861, 520	7, 220	245, 741	−13. 7	−23. 9
Grave vaults and covers	324, 680	2, 940	73, 017	274, 640	2, 070	64, 821	−15. 4	−11. 2
Blackboards and bulletin boards	1, 651, 010	4, 400	357, 043	1, 637, 570	4, 220	347, 486	−. 8	−2. 7
Billiard-table tops	47, 020	350	15, 794	60, 150	440	19, 582	+27. 9	+24. 0
School slates	[1] 578, 930	570	11, 930	[1] 520, 200	530	13, 179	−10. 1	+10. 5
Total millstock	4, 194, 160	21, 480	1, 225, 645	3, 575, 220	16, 310	853, 602	−14. 8	−30. 4
Flagstones, etc.[2]	1, 215, 490	8, 670	73, 554	1, 046, 530	7, 790	63, 839	−13. 9	−13. 2
Total slate as dimension stone		167, 550	4, 027, 308		143, 690	3, 165, 351	−14. 2	−21. 4
Granules and flour		277, 010	1, 578, 014		349, 000	2, 489, 962	+26. 0	+57. 8
Grand total domestic production		444, 560	5, 605, 322		492, 690	5, 655, 313	+10. 8	+. 9
Foreign trade:								
Imports for consumption			4, 824			6, 688		+38. 6
Exports:[3]								
Roofing	1, 025		9, 382	660		5, 070	−35. 6	−46. 0
Other dimension slate			65, 193			58, 852		−9. 7
Granules and flour		11, 184	77, 576		11, 229	93, 675	+. 4	+20. 8

[1] 1937, 1,083,600 pieces; 1938, 972,780 pieces; 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 in recent years—that is, all slate sold in blocks or slabs cut to specified sizes and shapes. Such a classification excludes granules and flour.

Slate (other than granules and flour) sold by producers in the United States, 1934–38

Year	Roofing			Millstock		Other [1]		Total	
	Squares	Approximate equivalent short tons	Value	Approximate short tons	Value	Approximate short tons	Value	Approximate short tons	Value
1934	137,010	51,640	$1,033,164	11,580	$581,959	3,350	$26,705	66,570	$1,641,828
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

[1] Includes flagstones, walkways, stepping stones, and miscellaneous slate.

Figure 1 compares sales of slate, except granules and flour, with the value of contracts awarded for residential building and total building from 1929 to 1938. Slate sales followed closely the trends in building construction until 1938, but in that year slate experienced a radical decline.

Granules and flour.—Slate granules are used quite extensively for surfacing prepared roofing, and slate flour is employed as a filler in roofing mastic, linoleum, and other products. The following table shows sales of granules and flour by producers from 1934 to 1938:

Crushed slate (granules and flour) sold by producers in the United States, 1934–38

Year	Granules		Flour		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	123,290	$902,078	42,870	$164,022	166,160	$1,066,100
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

Trends in roofing slate.—Residential building is the principal market for roofing slate. Slate is used for new construction and reroofing, but no figures are available as to the proportion used for each. New construction is, however, the principal market. No statistics are available 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 1929 to 1938. The chart indicates that slate did not suffer as severe a recession as residential building from 1929 to 1934 and that in 1935 and 1936 slate sales gained more rapidly than construction contracts; however, in 1937 slate sales dropped slightly, and in 1938 they experienced a sharp decline, although floor space of new residential construction made moderate gains during these years.

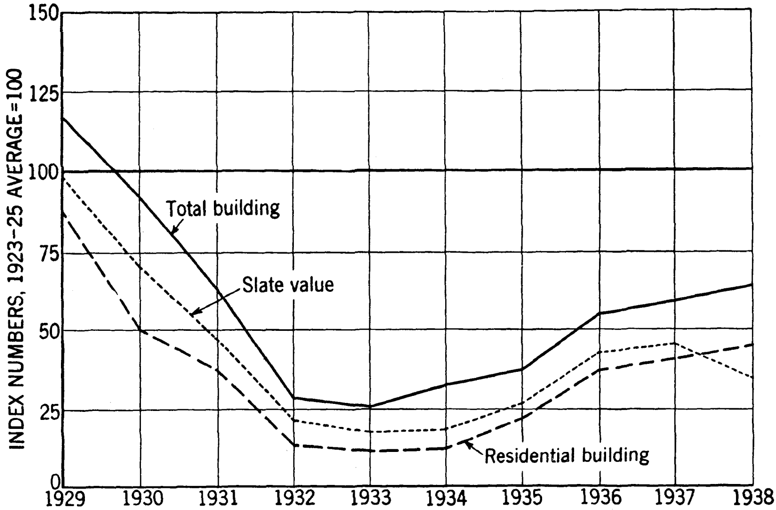

FIGURE 1.—Sales of slate compared with residential building and total building, 1929–38. Data on building from the F. W. Dodge Corporation.

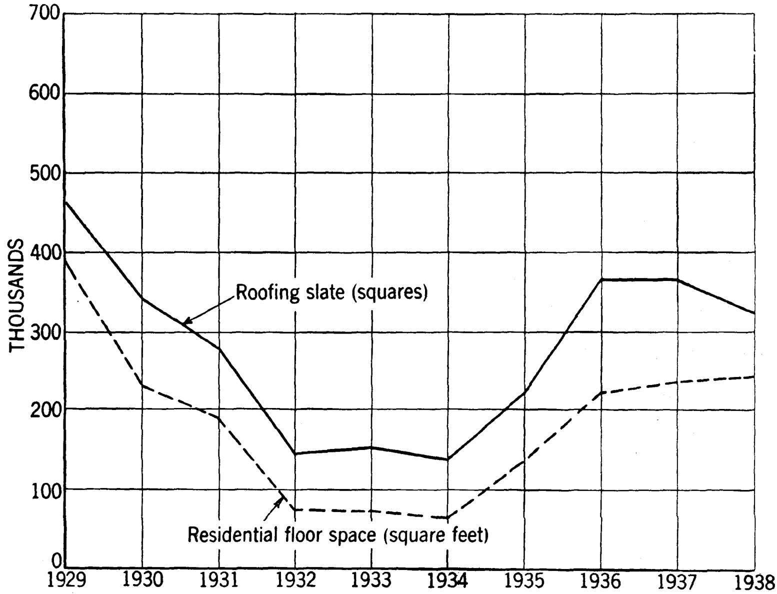

FIGURE 2.—Sales of roofing slate compared with residential floor space, 1929–38. Statistics on floor space from the F. W. Dodge Corporation.

PRICES

Prices of roofing slate f. o. b. quarry or mill, as reported to the Bureau of Mines by producers, declined 48 cents a square in 1938 compared with 1937. In Pennsylvania the price dropped 50 cents a square; in the New York-Vermont area, 75 cents; but in Virginia the price advanced 8 cents a square.

Average millstock prices fell from 29 cents a square foot in 1937 to 24 cents in 1938. Blackboards, bulletin boards, and electrical slate sold at 1 cent a square foot less than in 1937. Structural and sanitary slate fell 3 cents a square foot; vaults and covers advanced 2 cents, and school slates were a little higher than in 1937.

Trends in recent years.—Figure 3 shows the trend of slate prices over a 10-year period compared with prices of building materials in

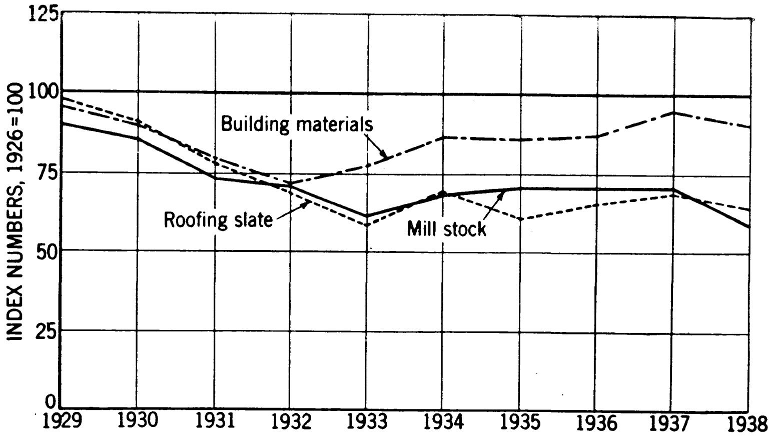

FIGURE 3.—Prices of slate compared with commodity prices of building materials in general, 1929–38. Commodity prices are from the Bureau of Labor Statistics.

general. The drop in price of roofing slate was comparable with that of building materials, but millstock prices fell abnormally.

REVIEW BY STATES AND DISTRICTS

The following table shows sales of slate in 1938 by States and uses:

Slate sold by producers in the United States in 1938, by States and uses

State	Operators	Roofing		Millstock		Other uses [1] (value)	Total value
		Squares (100 square feet)	Value	Square feet	Value		
Arkansas	1					(2)	(2)
California	3					$27,877	$27,877
Georgia	1					(2)	(2)
Maine	2	(2)	(2)	(2)	(2)	(2)	(2)
Maryland	1					(2)	(2)
New York	17	2,780	$26,340	(3)	(3)	[3] 418,991	445,331
Pennsylvania	30	195,560	1,293,426	3,292,330	$664,006	544,045	2,501,477
Tennessee	2	(2)	(2)	(2)	(2)	(2)	(2)
Vermont	51	83,490	577,279	135,750	68,279	1,084,097	1,729,655
Virginia	5	34,440	300,527			68,533	369,060
Undistributed [4]		5,770	50,338	147,140	121,317	410,258	581,913
	113	322,040	2,247,910	3,575,220	853,602	2,553,801	5,655,313

[1] Flagging and similar products, granules, and flour.
[2] Included under "Undistributed."
[3] A small amount of millstock included under "Other uses."
[4] Includes output of States entered as "(2)" above.

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Maine.—The principal product of the Maine quarries is electrical slate, the production of which suffered the most serious decline in its history. The Rising & Nelson Slate Co. has discontinued its operations in Maine.

New York-Vermont.—The slate area on the New York-Vermont border furnishes attractive green, purple, mottled, and red roofing slates, but sales of these products dropped sharply in 1938. Sales of millstock were only about half as large as in 1937, but sales of granules and flour made decisive gains. The value of all slate products sold in Vermont in 1938 was 21 percent greater than in 1937, the increase in granule sales more than compensating for the drastic decline in other products.

Peach Bottom district.—The chief output of the Peach Bottom district on the Maryland-Pennsylvania border is granules, but excellent roofing slate is available. At present the Funkhouser Co. is the only producer of roofing slate in this area.

Lehigh district.—The Lehigh district, comprising Lehigh and Northampton Counties, Pa., is the most productive slate area in the United States and furnishes all types of slate products. As separate figures cannot be shown for York County, it is included with Northampton County in the table.

Slate sold by producers in Pennsylvania in 1938, by counties and uses

County	Operators	Roofing slate		Millstock [1]			
				Electrical		Structural and sanitary [2]	
		Squares (100 square feet)	Value	Square feet	Value	Square feet	Value
Lehigh	10	11,850	$80,363	16,590	$6,989	24,970	$5,871
Northampton and York [3]	20	183,710	1,213,063	4,820	3,094	1,028,030	267,805
	30	195,560	1,293,426	21,410	10,083	1,053,000	273,676

County	Millstock—Continued [1]				Other uses (value) [4]	Total value
	Blackboards and bulletin boards		School slates			
	Square feet	Value	Square feet	Value		
Lehigh	414,780	$93,030	[5] 520,200	[5] $13,179	([6])	[5 6] $199,432
Northampton and York [3]	1,222,790	254,456	([5])	([5])	[6] $563,627	[5 6] 2,302,045
	1,637,570	347,486	520,200	13,179	563,627	2,501,477

[1] Exclusive of billiard-table material, value of which is included under "Other uses."
[2] Includes slate for grave covers and vaults.
[3] York County produced roofing slate, granules, and flour only.
[4] Includes 60,150 square feet of billiard-table material valued at $19,582.
[5] Small amount of school slates produced in Northampton County included under Lehigh County.
[6] Small amount of flagging produced in Lehigh County included under Northampton and York Counties.

Sales of roofing slate in 1938 in the Lehigh district (and York County) decreased 11 percent in quantity and 17 percent in value from those in 1937. Electrical slate sales were only about one-third as great as in 1937, while structural and sanitary products and school slates exhibited a moderate decline. Sales of blackboards and bulletin boards were nearly as great as in 1937. Sales of billiard-table material and granules alone gained in 1938. The value of total sales of slate products was 9 percent less in 1938 than in 1937.

Virginia.—The slate industry of Buckingham County is devoted chiefly to the production of roofing slate. Sales achieved a moderate gain with average prices a little higher than in 1938.

Other districts.—Arkansas, California, Georgia, and Tennessee reported a small output, chiefly of granules and flagging. The Maryland Slate Corporation, Silver Spring, Md., is reopening a quarry that was operated in a small way many years ago in Frederick County, Md. The principal product will be blue-black roofing slate similar to that obtained in the Peach Bottom district.

NEW DEVELOPMENTS

Investigations by the Building Research Station of the Department of Scientific and Industrial Research, London, England, conducted a few years ago, indicated that when slate is calcined at a high temperature it is converted into a light, spongy mass that will float on water. Similar results were obtained by the Eastern Experiment Station of the Bureau of Mines by calcining Pennsylvania slate. If a satisfactory commercial product can be made, a market may be developed for waste slate in the form of light-weight aggregate.

A detailed discussion of the domestic and foreign slate industries has recently appeared.[1]

FOREIGN TRADE [2]

Imports.—The value of slate imported for consumption in the United States in 1938 was 39 percent greater than in 1937, but imports are relatively unimportant. The following table shows the value of imports in 1937 and 1938 by countries:

Slate imported for consumption in the United States, 1937–38, by countries

Country	1937	1938	Country	1937	1938
Canada	$826	$543	Italy	$349	$994
China		3	Japan	222	68
Czechoslovakia	990	1,037	Norway	381	
France		895	United Kingdom	2,019	3,089
Germany	17				
Hong Kong	20	59		4,824	6,688

Exports.—In 1936 and following years exports of roofing slate were included with exports of stone in the tabulations of the Bureau of Foreign and Domestic Commerce; therefore separate figures from that source cannot be given. The following table shows exports of slate products from 1936 to 1938, as reported to the Bureau of Mines by shippers. Roofing, electrical, billiard tables, and structural slate exports show large declines; school slates, a moderate gain; and blackboards, a large gain. Slate granules and flour evidence a small gain in quantity and a larger gain in value.

[1] Bowles, Oliver, The Stone Industries, 2d ed.: McGraw-Hill Book Co., Inc., New York, 1939, 519 pp.

[2] 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.

Slate exported from the United States, 1936–38, by uses [1]

Use	1936 Quantity	1936 Value	1937 Quantity	1937 Value	1938 Quantity	1938 Value
Roofing ... squares	(2)	(2)	1,025	$9,382	660	$5,070
School slates ... cases [3]	2,651	$20,204	4,434	35,011	4,642	35,717
Electrical slate ... square feet	5,528	4,449	3,986	2,356	1,885	1,239
Blackboards ... do	53,486	15,502	26,033	6,853	46,253	10,400
Billiard tables ... do	26,729	10,601	30,443	16,580	17,788	10,182
Structural [4] ... do	25,592	5,831	26,462	4,393	18,188	1,314
Slate granules and flour ... short tons	9,412	67,012	11,184	77,576	11,229	93,675
	----------	[5] 123,599	----------	152,151	----------	157,597

[1] Figures collected by Bureau of Mines from shippers of products named.
[2] Figures not available.
[3] 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).
[4] Includes slate for floors and walkways.
[5] Excludes roofing.

SAND AND GRAVEL

By H. Herbert Hughes and G. Egge

SUMMARY OUTLINE

Outstanding in the sand and gravel industry in 1938 was the further shift to noncommercial operations for supplies of aggregates. The output of plants operated by States, counties, municipalities, and other Government agencies, as reported to the Bureau of Mines, was 17 percent higher than in 1937 and comprised 42 percent of the total tonnage. Commercial production dropped 16 percent. The

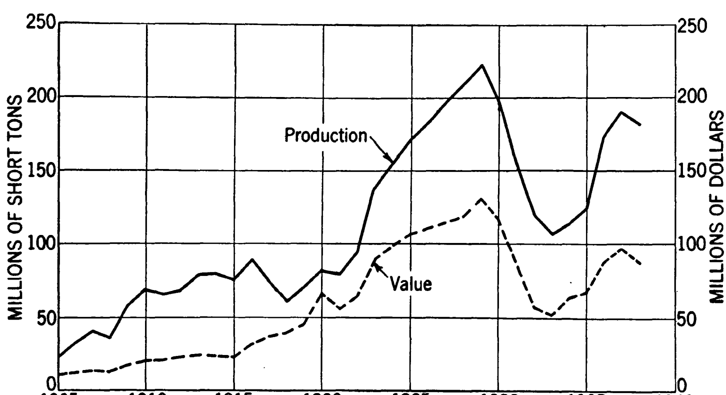

FIGURE 1.—Principal trends in the sand and gravel industry, 1905–38.

total quantity of sand and gravel sold or used for all purposes decreased 4 percent from 1937, and this decline correlates closely with statistics of construction and other indicators of outlets for sand and gravel. The drop in 1938 interrupted the continuous rise from the low in 1933. (See fig. 1.)

The total value of construction contracts awarded in 1938 was 10 percent higher than in 1937, but this rise was due entirely to sharp gains late in the year which, for the most part, did not result in demand for materials until early in 1939. A similar situation existed in contracts awarded for engineering construction and concrete paving, which advanced 15 and 11 percent, respectively. Construction financed by public funds increased 48 percent and contracts for public works 45 percent in 1938 compared with 1937. Despite a drop of 15 percent in privately financed construction, residential contract awards were 9 percent above 1937. Residential construction was particularly active in the last quarter of 1938.

In general, prices of sand and gravel in 1938 were slightly below those in 1937, although producers reported an increase in the average value per ton for some industrial sands. In 1938, as in earlier years, the average value of the noncommercial output was low—a reflection of the high percentage of unprepared material included in this category.

Salient statistics of the sand and gravel industry in 1937 and 1938 are summarized in the following table.

Sand and gravel sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations and by uses

	1937			1938				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
COMMERCIAL OPERATIONS								
Sand:								
Glass	2,799,230	$4,746,629	$1.70	2,109,462	$3,601,734	$1.71	−24.6	+0.6
Molding	4,953,873	5,239,435	1.06	2,319,902	2,651,779	1.14	−53.2	+7.5
Building	26,050,459	14,809,078	.57	22,939,683	12,888,823	.56	−11.9	−1.8
Paving	17,395,013	9,487,817	.55	16,755,634	9,388,865	.56	−3.7	+1.8
Grinding and polishing	1,067,178	1,440,736	1.35	[1] 502,328	[1] 754,805	1.50	−52.9	+11.1
Fire or furnace	258,287	268,355	1.04	108,093	124,343	1.15	−58.2	+10.6
Engine	1,802,869	1,092,171	.61	1,378,450	786,639	.57	−23.5	−6.6
Filter	99,383	182,414	1.84	93,711	137,283	1.46	−5.7	−20.7
Railroad ballast [2]	1,418,316	334,585	.24	786,435	212,935	.27	−44.6	+12.5
Other	1,295,419	1,058,162	.82	1,339,556	1,124,739	.84	+3.4	+2.4
Total commercial sand	57,140,027	38,659,382	.68	48,333,254	31,671,945	.66	−15.4	−2.9
Gravel:								
Building	24,876,957	18,130,011	.73	19,014,937	13,283,044	.70	−23.6	−4.1
Paving	30,156,314	17,991,964	.60	29,180,197	17,391,259	.60	−3.2	
Railroad ballast [3]	12,318,575	3,757,068	.30	8,194,244	2,255,355	.28	−33.5	−6.7
Other	850,605	575,893	.68	1,037,154	414,275	.40	+21.9	−41.2
Total commercial gravel	68,202,451	40,454,936	.59	57,426,532	33,343,933	.58	−15.8	−1.7
Total commercial sand and gravel	125,342,478	79,114,318	.63	105,759,786	65,015,878	.61	−15.6	−3.2
NONCOMMERCIAL OPERATIONS [4]								
Sand:								
Building	1,540,280	595,953	.39	2,157,501	890,224	.41	+40.1	+5.1
Paving	4,704,764	1,157,162	.25	6,623,073	1,373,556	.21	+40.8	−16.0
Total noncommercial sand	6,245,044	1,753,115	.28	8,780,574	2,263,780	.26	+40.6	−7.1

See footnotes at end of table.

Sand and gravel sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations and by uses—Continued

	1937			1938				
	Short tons	Value		Short tons	Value		Percent of change in—	
		Total	Average		Total	Average	Tonnage	Average value
NONCOMMERCIAL OPERATIONS—continued.								
Gravel:								
Building	2,961,360	$1,396,202	$0.47	7,299,822	$2,454,783	$0.34	+146.5	−27.7
Paving	55,111,541	15,209,362	.28	59,480,051	16,188,406	.27	+7.9	−3.6
Total noncommercial gravel	58,072,901	16,605,564	.29	66,779,873	18,643,189	.28	+15.0	−3.4
Total noncommercial sand and gravel	64,317,945	18,358,679	.29	75,560,447	20,906,969	.28	+17.5	−3.4
COMMERCIAL AND NONCOMMERCIAL OPERATIONS								
Sand	63,385,071	40,412,497	.64	57,113,828	33,935,725	.59	−9.9	−7.8
Gravel	126,275,352	57,060,500	.45	124,206,405	51,987,122	.42	−1.6	−6.7
Grand total	189,660,423	97,472,997	.51	181,320,233	85,922,847	.47	−4.4	−7.8

[1] Includes 205,753 tons of blast sand valued at $509,178.
[2] Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for railroad ballast in 1937 was 1,330,204 tons valued at $315,988 and in 1938, 672,829 tons, $195,469. The figures include sand produced by railroads for their own use as follows—1937: Ballast, 201,488 tons, $21,363, and fills and similar purposes, 88,112 tons, $18,597; 1938: Ballast, 128,079 tons, $25,806, and fills and similar purposes, 113,606 tons, $17,466.
[3] Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for railroad ballast in 1937 was 11,527,192 tons valued at $3,650,278 and in 1938, 7,271,502 tons, $2,179,462. The figures include gravel produced by railroads for their own use as follows—1937: Ballast, 5,343,956 tons, $843,851, and fills and similar purposes, 791,383 tons, $106,790; 1938: Ballast, 3,590,684 tons, $645,133, and fills and similar purposes, 922,742 tons, $75,893.
[4] By States, counties, municipalities, and other Government agencies directly or under lease.

Sales of sand and gravel by commercial producers for all major uses were lower in 1938 than in 1937. Sales of paving sand and gravel dropped 4 and 3 percent, respectively, whereas output of noncommercial paving sand and gravel increased appreciably. This would seem to indicate increased activity in low-cost road construction, but a drop of 9 percent in road-oil sales and increases of 11 and 9 percent, respectively, in concrete paving and domestic demand for asphalt do not support this inference.

As was indicated by data on construction, total sales of building sand and gravel in 1938 were 9 and 5 percent, respectively, lower than in 1937. Sharp increases of 40 and nearly 150 percent in noncommercial building sand and gravel failed to offset decreases of 12 and 24 percent, respectively, in commercial output. The rise in noncommercial production was related to the WPA program.

Sales of some industrial sands were less than half those in 1937. The output of glass sand was 25 percent lower in 1938, owing to decreases of 18 and 56 percent, respectively, in production of glass containers and polished plate glass. Curtailment of activity in the iron and steel and foundry industries resulted in declines of more than 50 percent in output of molding and fire or furnace sands. Grinding and polishing sand also dropped more than 50 percent. Sharp decreases in engine sand and railroad-ballast sand and gravel were due to the continued depressed condition of the railroads. The output of filter sand dropped only 6 percent. The only increase in quantity in 1938 was in material unclassified as to use.

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.

The relative importance of gravel continued to increase in 1938. It comprised 69 percent of the total tonnage compared with 67 percent in 1937 and only 53 percent in 1928. This increase shows that the use of gravel is expanding, although a large part of the rise represents noncommercial production used in low-type roads.

Complete production data for 1938 are included in this report. Statistics of sand and gravel sold or used by commercial and noncommercial producers from 1934 to 1938 are summarized in the following table.

Sand and gravel sold or used by commercial and noncommercial producers in the United States, 1934–38

Year	Sand		Gravel (including railroad ballast)		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	38,400,090	$24,881,071	78,211,599	$36,366,102	116,611,689	$61,247,173
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

New York, Illinois, and California led all States in output of sand and gravel in 1938, although Pennsylvania ranked third on the basis of value because of its large production of glass and other high-priced industrial sands. Details of production in 1938 by States and uses are given in the following tables. This year, for the first time, the table by States is designed to show the break-down by commercial and noncommercial producers.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses

State	Sand							
	Glass		Molding		Building			
					Commercial		Noncommercial	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			[1]	[1]	226,399	$89,493	42,500	$1,840
Alaska					[1]	[1]	[1]	[1]
Arizona					94,360	55,854	203,215	87,595
Arkansas	[1]	[1]	[1]	[1]	139,755	74,517	25,845	31,981
California	[1]	[1]	30,445	$71,813	3,227,145	2,034,512	174,515	69,417
Colorado					121,529	71,969	90,558	32,686
Connecticut			[1]	[1]	271,880	164,392	[1]	[1]
Delaware			[1]	[1]	56,940	34,388		
Florida					457,434	234,534	10,234	1,375
Georgia	16,688	$13,110	[1]	[1]	98,893	35,166	[1]	[1]
Hawaii							[1]	[1]
Idaho					9,561	6,334	43,127	36,946
Illinois	[1]	[1]	359,363	356,799	1,023,497	506,307	121,821	36,687
Indiana			124,297	81,921	951,064	405,181	110,971	73,490
Iowa			[1]	[1]	398,025	234,268	17,588	2,289
Kansas					457,206	199,270	64,711	23,567
Kentucky			3,331	7,722	299,231	285,756	[1]	[1]
Louisiana					415,756	164,661		
Maine					11,189	4,717	2,800	200
Maryland	[1]	[1]			410,137	344,768	[1]	[1]
Massachusetts			[1]	[1]	783,835	378,386	16,279	6,072
Michigan	[1]	[1]	471,680	160,888	886,107	274,609	13,449	8,007
Minnesota			12,546	13,125	622,334	233,870	174,810	31.362
Mississippi					48,724	15,773	[1]	[1]
Missouri	167,605	255,243	21,088	17,013	443,824	223,170	[1]	[1]
Montana					31,947	25,848	[1]	[1]
Nebraska					205,181	62,922		
Nevada	[1]	[1]	6,127	10,497	22,317	18,278	3,695	1,752
New Hampshire					9,481	4,077	5,404	386
New Jersey	273,363	419,104	383,842	551,304	884,882	415,818	10,812	638
New Mexico					[1]	[1]	13,783	4,999
New York			249,792	403,418	4,081,616	1,923,623	116,342	16,408
North Carolina					60,165	28,218	19,065	8,862
North Dakota					20,914	4,403	30,275	1,528
Ohio	[1]	[1]	297,791	507,916	1,283,601	851,595	10,712	5,488
Oklahoma	[1]	[1]			183,242	77,597	[1]	[1]
Oregon					169,315	116,380	[1]	[1]
Pennsylvania	[1]	[1]	164,314	254,017	1,160,031	1,112,035	[1]	[1]
Rhode Island			[1]	[1]	26,832	9,442	3,710	1,265
South Carolina	[1]	[1]			88,170	48,664	4,795	2,619
South Dakota					54,320	29,238	7,846	3,439
Tennessee			[1]	[1]	377,077	328,851	90,134	92,130
Texas	[1]	[1]	3,852	6,591	572,437	402,379	410,186	172,819
Utah			[1]	[1]	106,989	49,229	22,299	4,006
Vermont							19,270	17,343
Virginia	[1]	[1]	6,415	4,029	410,985	329,932	40,822	6,454
Washington			[1]	[1]	897,458	508,433	19,020	10,053
West Virginia	[1]	[1]	[1]	[1]	211,266	204,379	[1]	[1]
Wisconsin			48,181	22,306	593,490	230,500	145,540	36,075
Wyoming					8,958	13,435	43,335	44,081
Undistributed [2]	1,651,806	2,914,277	136,838	182,420	24,184	21,652	28,033	16,365
	2,109,462	3,601,734	2,319,902	2,651,779	22,939,683	12,888,823	2,157,501	890,224

See footnotes at end of table.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses—Continued

State	Sand—Continued							
	Paving				Grinding and polishing [3]		Fire or furnace	
	Commercial		Noncommercial					
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	129,532	$91,960	2,048,145	$163,002				
Alaska								
Arizona	(1)	(1)	26,335	9,652				
Arkansas	104,872	62,119	(1)	(1)				
California	1,146,664	633,554	116,154	55,046	11,763	$31,513	(1)	(1)
Colorado	44,216	25,410	139,378	12,948	(1)	(1)		
Connecticut	121,613	66,662	476,468	37,701	(1)	(1)		
Delaware	7,367	3,948			(1)	(1)		
Florida	132,921	82,365	7,000	1,000				
Georgia	206,663	103,087	(1)	(1)	8,438	9,303		
Hawaii								
Idaho	(1)	(1)	74,857	18,735				
Illinois	1,034,799	489,329	52,440	18,226	61,175	184,258	10,432	$16,864
Indiana	690,022	345,580	(1)	(1)			26,350	9,250
Iowa	622,169	279,129	(1)	(1)	10,095	9,759		
Kansas	651,602	256,251	114,400	35,638	16,613	6,730		
Kentucky	213,494	129,478						
Louisiana	243,437	131,935			(1)	(1)		
Maine	25,202	9,322	15,581	7,984	(1)	(1)		
Maryland	624,834	491,686	(1)	(1)	(1)	(1)	(1)	(1)
Massachusetts	447,102	192,181	35,677	3,567	(1)	(1)	(1)	(1)
Michigan	1,180,803	444,206	139,508	21,387	46,389	30,947		
Minnesota	143,210	56,330	(1)	(1)	(1)	(1)		
Mississippi	521,025	207,818	205,443	51,406				
Missouri	419,507	232,759	8,836	5,647	51,361	81,572	(1)	(1)
Montana	8,980	8,775	8,904	3,250				
Nebraska	83,757	25,885	64,064	18,090	(1)	(1)		
Nevada	148	109	9,897	3,454	916	2,106		
New Hampshire	30,688	11,940	614,914	39,174				
New Jersey	800,835	429,954			47,481	98,932	13,907	22,016
New Mexico			52,920	36,859				
New York	1,996,109	973,873	33,524	9,715	(1)	(1)		
North Carolina	140,815	78,787	1,375,686	291,557				
North Dakota	24,383	9,185	6,383	823				
Ohio	1,163,257	698,066	17,880	7,810	(1)	(1)	(1)	(1)
Oklahoma	74,934	32,380	20,636	6,003				
Oregon	69,193	35,594	11,200	5,200				
Pennsylvania	1,237,875	1,252,905	(1)	(1)	120,874	121,710	12,880	23,071
Rhode Island	22,084	11,314	30,677	22,137				
South Carolina	47,232	24,027	101,948	25,119				
South Dakota	72,012	36,588	28,614	6,680				
Tennessee	305,351	207,357	30,811	27,332	19,685	27,061	713	785
Texas	659,497	385,935	100,231	95,091	1,054	1,042		
Utah	38,049	18,085	133,706	81,069				
Vermont	17,303	13,020	9,927	4,803	39,367	1,405		
Virginia	537,420	382,248	160,665	56,108				
Washington	124,002	63,474	169,652	63,481				
West Virginia	155,607	132,964	9,303	12,718	(1)	(1)		
Wisconsin	406,488	198,659	146,802	100,072	36,477	59,376	4,270	3,843
Wyoming	2,223	2,078	10,257	10,346				
Undistributed [2]	26,338	20,554	14,250	4,726	30,640	89,091	39,541	48,514
	16,755,634	9,388,865	6,623,073	1,373,556	502,328	754,805	108,093	124,343

See footnotes at end of table.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses—Continued

State	Sand—Continued							
	Engine		Filter		Railroad ballast [4]		Other	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)						
Alaska								
Arizona	4,454	$2,316			1,111	$889	4,200	$1,680
Arkansas	(1)	(1)						
California	28,516	10,442	(1)	(1)	(1)	(1)	9,877	8,571
Colorado	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Connecticut	(1)	(1)	(1)	(1)	100	50	13,274	7,473
Delaware	(1)	(1)	(1)	(1)			(1)	(1)
Florida	(1)	(1)	(1)	(1)	18,306	3,639	9,909	6,556
Georgia	20,464	5,751	909	$2,727			13,390	8,695
Hawaii								
Idaho	(1)	(1)					780	323
Illinois	38,235	22,501	(1)	(1)	191,565	51,032	172,114	181,675
Indiana	95,702	31,089			(1)	(1)	(1)	(1)
Iowa	37,885	20,282	(1)	(1)	18,594	11,308	10,410	2,642
Kansas	32,533	14,998	(1)	(1)			45,772	18,283
Kentucky	(1)	(1)			7,424	3,341	(1)	(1)
Louisiana	10,107	3,485	(1)	(1)	20,785	4,638	(1)	(1)
Maine	2,998	904	(1)	(1)	8,121	2,099		
Maryland	(1)	(1)						
Massachusetts	25,925	7,488	4,150	1,920	487	73	27,896	12,922
Michigan	11,433	3,779			(1)	(1)	71,337	18,858
Minnesota	34,771	7,858	516	1,548	48,848	10,825	(1)	(1)
Mississippi	17,053	4,710			(1)	(1)	(1)	(1)
Missouri	23,354	12,435	(1)	(1)	14,793	8,147	(1)	(1)
Montana	3,517	351			11,616	1,437		
Nebraska	46,700	15,439	(1)	(1)			12,445	2,741
Nevada	480	560	(1)	(1)	5,800	462	(1)	(1)
New Hampshire							(1)	(1)
New Jersey	(1)	(1)	39,510	52,540			(1)	(1)
New Mexico	(1)	(1)			(1)	(1)		
New York	60,893	27,926	5,913	2,680	(1)	(1)	296,126	90,140
North Carolina	(1)	(1)	(1)	(1)	12,097	7,362	33,840	14,423
North Dakota								
Ohio	45,494	33,826	12,034	12,753	54,419	13,623	114,471	336,702
Oklahoma	20,927	9,662	(1)	(1)	8,353	1,819	1,966	841
Oregon	16,222	3,860			(1)	(1)	(1)	(1)
Pennsylvania	178,354	185,076	(1)	(1)	(1)	(1)	137,496	164,129
Rhode Island							(1)	(1)
South Carolina	1,645	352			21,588	2,608		
South Dakota	(1)	(1)			(1)	(1)		
Tennessee	32,795	30,436			(1)	(1)	(1)	(1)
Texas	28,024	10,284	(1)	(1)	142,821	26,782	(1)	(1)
Utah	(1)	(1)					(1)	(1)
Vermont	800	555						
Virginia	(1)	(1)					(1)	(1)
Washington	23,662	5,376			(1)	(1)	(1)	(1)
West Virginia	207,893	157,798	(1)	(1)	(1)	(1)	20,347	48,045
Wisconsin	44,810	9,334	6,594	5,865	25,615	4,168	8,461	3,473
Wyoming								
Undistributed [2]	282,804	147,766	24,085	57,250	173,992	58,633	335,445	196,567
	1,378,450	786,639	93,711	137,283	786,435	212,935	1,339,556	1,124,739

See footnotes at end of table.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses—Continued

State	Gravel							
	Building				Paving			
	Commercial		Noncommercial		Commercial		Noncommercial	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	217, 865	$121, 619	12, 220	$12, 100	316, 825	$235, 694	44, 300	$18, 021
Alaska	(1)	(1)	4, 309	1, 847	(1)	(1)	128, 762	35, 453
Arizona	192, 901	104, 219	530, 309	214, 515	(1)	(1)	57, 910	38, 629
Arkansas	28, 839	18, 764	32, 200	3, 300	216, 769	150, 950	817, 680	250, 578
California	3, 064, 989	2, 258, 186	594, 580	372, 593	1, 829, 134	1, 173, 909	1, 182, 582	501, 006
Colorado	113, 005	83, 111	338, 957	71, 208	398, 841	185, 260	2, 530, 415	919, 810
Connecticut	144, 005	110, 589	------	------	70, 514	36, 588	209, 594	79, 427
Delaware	3, 250	3, 737	------	------	777	699	------	------
Florida	(1)	(1)	------	------	(1)	(1)	------	------
Georgia	------	------	(1)	(1)	(1)	(1)	17, 134	12, 514
Hawaii	------	------	------	------	------	------	(1)	(1)
Idaho	58, 158	15, 579	444, 976	169, 490	134, 007	51, 165	1, 114, 026	410, 762
Illinois	1, 081, 856	565, 303	77, 778	29, 946	2, 781, 580	1, 169, 935	3, 936, 774	1, 134, 734
Indiana	658, 490	452, 887	87, 140	54, 306	1, 889, 844	1, 214, 533	330, 304	70, 493
Iowa	355, 624	291, 231	456, 841	65, 195	1, 308, 040	586, 234	3, 510, 819	689, 251
Kansas	89, 943	38, 977	335, 160	127, 020	537, 011	247, 753	610, 425	143, 174
Kentucky	326, 012	308, 612	(1)	(1)	267, 571	184, 838	------	------
Louisiana	567, 481	356, 798	------	------	654, 202	437, 801	60, 343	4, 310
Maine	25, 393	16, 754	5, 158	552	118, 034	38, 453	3, 393, 632	836, 779
Maryland	308, 211	291, 830	(1)	(1)	579, 650	664, 780	226, 835	16, 202
Massachusetts	412, 259	298, 686	305, 596	30, 481	370, 892	186, 884	505, 314	46, 774
Michigan	757, 742	424, 242	412, 880	141, 784	2, 287, 953	966, 316	3, 186, 938	945, 493
Minnesota	474, 637	398, 270	213, 108	73, 231	560, 342	253, 799	5, 251, 134	337, 777
Mississippi	92, 411	39, 936	49, 357	2, 115	1, 222, 245	668, 305	993, 497	230, 123
Missouri	373, 044	220, 669	(1)	(1)	841, 379	403, 409	773, 562	361, 423
Montana	441, 964	169, 091	82, 692	27, 404	289, 800	212, 225	1, 624, 961	524, 231
Nebraska	365, 625	127, 790	20, 200	5, 250	1, 042, 496	381, 278	1, 085, 602	377, 638
Nevada	------	------	26, 869	3, 706	292, 191	109, 104	1, 244, 327	362, 446
New Hampshire	12, 549	12, 306	------	------	68, 993	55, 494	1, 422, 691	111, 598
New Jersey	266, 594	211, 660	77, 771	6, 528	343, 513	262, 724	(1)	(1)
New Mexico	(1)	(1)	46, 374	63, 141	------	------	1, 856, 160	1, 066, 205
New York	2, 312, 829	1, 631, 062	243, 160	28, 334	1, 751, 586	1, 071, 788	2, 377, 077	301, 622
North Carolina	(1)	(1)	(1)	(1)	60, 536	49, 569	676, 944	179, 341
North Dakota	8, 754	8, 992	412, 714	16, 205	100, 339	22, 833	1, 903, 087	81, 128
Ohio	965, 946	676, 469	48, 899	7, 635	2, 538, 326	1, 668, 214	723, 095	145, 098
Oklahoma	20, 800	12, 523	296, 670	73, 388	113, 719	79, 967	57, 197	24, 950
Oregon	227, 155	143, 099	150, 921	98, 115	357, 416	168, 674	884, 917	293, 435
Pennsylvania	810, 077	757, 590	------	------	1, 156, 588	1, 085, 905	299, 964	54, 312
Rhode Island	15, 392	9, 056	(1)	(1)	48, 038	30, 047	109, 616	81, 207
South Carolina	91, 738	99, 329	------	------	65, 770	70, 762	------	------
South Dakota	13, 245	9, 105	217, 563	9, 921	43, 540	13, 625	4, 135, 504	506, 033
Tennessee	291, 141	218, 468	47, 881	39, 934	572, 115	361, 611	563, 561	171, 503
Texas	760, 427	668, 584	921, 150	390, 350	1, 178, 949	951, 790	1, 980, 452	514, 277
Utah	122, 075	57, 987	105, 301	14, 783	224, 827	74, 030	1, 948, 845	949, 523
Vermont	------	------	------	------	3, 100	221	913, 768	458, 285
Virginia	330, 854	339, 948	18, 297	18, 874	687, 954	705, 164	418, 416	213, 471
Washington	1, 557, 618	917, 346	64, 277	19, 755	508, 417	328, 484	2, 423, 178	909, 722
West Virginia	177, 004	157, 089	------	------	333, 636	265, 667	66, 734	39, 348
Wisconsin	421, 164	203, 004	526, 458	169, 933	862, 268	439, 626	2, 472, 214	1, 188, 093
Wyoming	12, 130	17, 856	83, 728	83, 690	69, 195	35, 616	1, 403, 916	550, 989
Undistributed [2]	443, 741	414, 691	8, 328	8, 154	81, 275	89, 536	5, 845	1, 218
	19,014,937	13,283,044	7,299,822	2,454,783	29, 180, 197	17,391,259	59, 480, 051	16, 188, 406

See footnotes at end of table.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States and uses—Continued

State	Gravel—Continued				Sand and gravel			
	Railroad ballast [5]		Other [6]		Total commercial		Total noncommercial	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Alabama			8,903	$3,237	963,018	$587,168	2,147,165	$194,963
Alaska					(1)	(1)	133,232	37,380
Arizona	(1)	(1)			367,196	198,903	817,769	350,391
Arkansas	247,623	$92,097	(1)	(1)	820,789	492,623	876,811	286,596
California	350,113	59,228	7,994	12,053	9,827,441	6,579,525	2,067,831	998,062
Colorado			(1)	(1)	742,451	396,323	3,099,308	1,036,652
Connecticut	(1)	(1)	(1)	(1)	689,501	405,349	687,462	117,428
Delaware					108,875	63,366		
Florida			(1)	(1)	979,447	669,731	17,234	2,375
Georgia			(1)	(1)	373,210	191,572	22,548	15,476
Hawaii							(1)	(1)
Idaho	81,743	5,856	(1)	(1)	291,082	85,424	1,676,986	635,933
Illinois	1,166,371	392,166	53,692	26,676	8,349,656	4,429,008	4,188,813	1,219,593
Indiana	414,400	180,567	61,369	28,016	4,948,011	2,758,187	531,537	200,286
Iowa	152,600	31,062	59,090	37,722	3,007,598	1,542,447	3,986,648	757,235
Kansas	(1)	(1)	(1)	(1)	1,838,135	787,654	1,124,696	329,399
Kentucky	(1)	(1)			1,212,233	957,800	(1)	(1)
Louisiana	273,617	133,642	(1)	(1)	2,188,314	1,237,145	60,343	4,310
Maine	192,840	50,082	(1)	(1)	385,533	123,251	3,417,171	845,515
Maryland			(1)	(1)	1,945,481	1,831,548	231,681	16,663
Massachusetts	158,091	20,233	(1)	(1)	2,601,179	1,141,491	862,866	86,894
Michigan	203,687	75,234	23,132	7,290	6,068,523	2,617,341	3,752,775	1,116,671
Minnesota	814,492	104,106	(1)	(1)	2,844,677	1,144,020	5,641,470	442,816
Mississippi	(1)	(1)			1,988,050	963,181	1,248,625	283,793
Missouri	82,975	50,684	(1)	(1)	2,484,198	1,550,014	785,658	369,132
Montana	436,321	88,353	3,577	2,026	1,227,722	508,106	1,718,850	556,168
Nebraska			(1)	(1)	1,759,038	619,828	1,169,866	400,978
Nevada	364,698	128,015			710,774	312,896	1,284,788	371,358
New Hampshire	(1)	(1)	(1)	(1)	452,198	91,882	2,043,009	151,158
New Jersey	(1)	(1)	19,495	22,095	3,121,223	2,511,409	94,183	8,166
New Mexico					(1)	(1)	1,969,237	1,171,204
New York	(1)	(1)	16,353	8,707	10,796,267	6,137,020	2,770,103	356,079
North Carolina	10,512	6,301			431,795	279,942	2,073,385	482,885
North Dakota	73,466	5,477	1,450	1,250	229,306	52,140	2,352,459	99,684
Ohio	432,106	205,354	48,009	47,714	7,141,920	5,469,186	800,586	166,031
Oklahoma			(1)	(1)	446,955	248,519	376,859	105,967
Oregon	163,387	51,161	(1)	(1)	1,028,491	528,837	1,050,535	397,824
Pennsylvania	(1)	(1)	34,162	28,482	5,418,875	5,700,086	302,136	59,910
Rhode Island			(1)	(1)	140,409	88,467	144,927	104,705
South Carolina	(1)	(1)	(1)	(1)	357,569	277,561	106,743	27,738
South Dakota	96,178	10,623			288,066	101,271	4,389,527	526,073
Tennessee	(1)	(1)	11,257	9,930	1,710,563	1,274,150	732,387	330,899
Texas	805,459	247,434	(1)	(1)	4,235,962	2,793,611	3,412,019	1,172,537
Utah	51,886	8,563			564,854	214,341	2,210,151	1,049,381
Vermont	99,860	35,054			160,430	50,255	942,965	480,431
Virginia	23,023	14,090	9,592	2,217	2,158,369	1,891,204	638,200	294,907
Washington	177,921	18,576	15,119	5,687	3,339,685	1,858,298	2,676,127	1,003,011
West Virginia	(1)	(1)	(1)	(1)	1,578,151	1,751,221	76,395	52,253
Wisconsin	394,545	86,777	130,047	38,822	2,982,410	1,305,753	3,291,014	1,494,173
Wyoming	259,870	23,192			352,376	92,177	1,541,236	689,106
Undistributed [2]	666,460	131,428	533,913	132,351	101,780	104,647	14,131	6,780
	8,194,244	2,255,355	1,037,154	414,275	105,759,786	65,015,878	75,560,447	20,906,969

1 Included under "Undistributed."
2 Includes items entered as "1."
3 Includes 205,753 tons of blast sand valued at $509,178.
4 Includes some sand used for fills and similar purposes. The quantity of sand reported as used exclusively for railroad ballast was 672,829 tons valued at $195,469. The figures include sand produced by railroads for their own use as follows: Ballast, 128,079 tons, $25,806, and fills and similar purposes, 113,606 tons, $17,466.
5 Includes some gravel used for fills and similar purposes. The quantity of gravel reported as used exclusively for railroad ballast was 7,271,502 tons valued at $2,179,462. The figures include gravel produced by railroads for their own use as follows: Ballast, 3,590,684 tons, $645,133, and fills and similar purposes. 922,742 tons, $75,893.
6 May include some gravel used by railroads for fills and miscellaneous purposes.

Sand and gravel sold or used by commercial and noncommercial producers in the United States in 1938, by States

State	Short tons	Value	State	Short tons	Value
Alabama	3,110,183	$782,131	Nebraska	2,928,904	$1,020,806
Alaska	[1] 133,232	[1] 37,380	Nevada	1,995,562	684,254
Arizona	1,184,965	549,294	New Hampshire	2,495,207	243,040
Arkansas	1,697,600	779,219	New Jersey	3,215,406	2,519,575
California	11,895,272	7,577,587	New Mexico	[1] 1,969,237	[1] 1,171,204
Colorado	3,841,759	1,432,975	New York	13,566,370	6,493,099
Connecticut	1,376,963	522,777	North Carolina	2,505,180	762,827
Delaware	108,875	63,366	North Dakota	2,581,765	151,824
Florida	996,681	672,106	Ohio	7,942,506	5,635,217
Georgia	395,758	207,048	Oklahoma	823,814	354,486
Hawaii	(2)	(2)	Oregon	2,079,026	926,661
Idaho	1,968,068	721,357	Pennsylvania	5,721,011	5,759,996
Illinois	12,538,469	5,648,601	Rhode Island	285,336	193,172
Indiana	5,479,548	2,958,473	South Carolina	464,312	305,299
Iowa	6,994,246	2,299,682	South Dakota	4,677,593	627,344
Kansas	2,962,831	1,117,053	Tennessee	2,442,950	1,605,049
Kentucky	1,222,658	962,508	Texas	7,647,981	3,966,148
Louisiana	2,248,657	1,241,455	Utah	2,775,005	1,263,722
Maine	3,802,704	968,766	Vermont	1,103,395	530,686
Maryland	2,177,162	1,848,211	Virginia	2,796,569	2,186,111
Massachusetts	3,464,045	1,228,385	Washington	6,015,812	2,861,309
Michigan	9,821,298	3,734,012	West Virginia	1,654,546	1,803,474
Minnesota	8,486,147	1,586,836	Wisconsin	6,273,424	2,799,926
Mississippi	3,236,675	1,246,974	Wyoming	1,893,612	781,283
Missouri	3,269,856	1,919,146	Undistributed [3]	105,486	106,719
Montana	2,946,572	1,064,274			
				181,320,233	85,922,847

[1] Output of commercial producers included under "Undistributed."
[2] Included under "Undistributed."
[3] Includes items covered by "1" and "2."

Noncommercial operations.—Recapitulations to show statistics of sand and gravel reported by States, counties, municipalities, and other Government agencies have now been carried back through 1923,

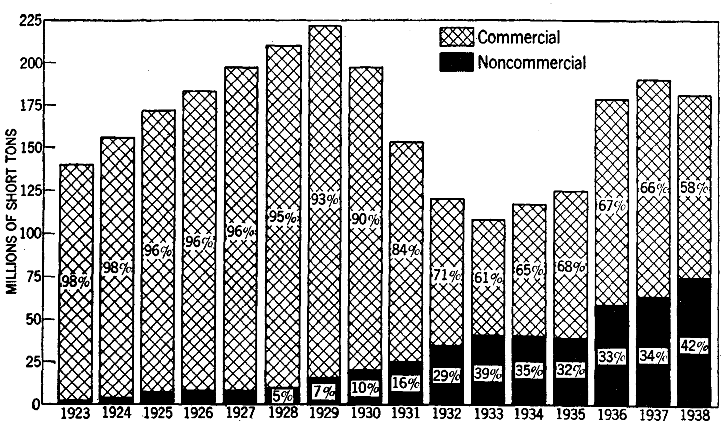

FIGURE 2.—Sand and gravel sold or used in the United States by commercial and noncommercial producers, 1923–38.

although the separate canvass of this material from noncommercial operations was not begun until 1932. Noncommercial production amounted to less than 2 percent of the total output in 1923, but during the depression it rose to more than a third of the total and in 1938 to 42 percent. (See fig. 2.)

The complete record of noncommercial production since 1923 is summarized in the following table:

Sand and gravel sold or used by noncommercial producers in the United States, 1923–38, by uses

Year	Sand				Gravel				Total noncommercial sand and gravel	
	Building		Paving		Building		Paving			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1923	[1] 75,392	[1] $61,990	205,282	$113,174	5,994	$4,534	1,828,808	$1,165,617	2,115,476	$1,345,315
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

[1] Includes a small quantity of filter sand.

In 1938, as in earlier years, most of the output of noncommercial operations (79 percent) was paving gravel, largely unprepared material for use in low-cost secondary roads. Building-sand and gravel output rose sharply to 13 percent of the total compared with only 7 percent in 1937.

Sand and gravel classed as noncommercial includes that reported by States, counties, municipalities, or other Government agencies, produced either by their own construction or maintenance crews or by contractors expressly for their consumption. Purchases from commercial producers are not included. The quantity produced by contractors was 41 percent of the total in 1938 and 40 percent in 1937. In 1938, as in previous years, more than half the production of noncommercial material was reported by States, about one-third by counties, and the rest by municipalities and other agencies. Details are given in the following table.

Sand and gravel sold or used by noncommercial producers in the United States, 1935–38, by types of producers

Type of producer	1935		1936		1937		1938	
	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	22,011,231	$0.22	31,206,204	$0.23	38,637,673	$0.21	44,745,693	$0.21
Contractors	17,305,221	.34	27,203,215	.40	25,680,272	.40	30,814,754	.37
	39,316,452	.27	58,409,419	.31	64,317,945	.29	75,560,447	.28
States	22,016,880	.32	33,004,590	.34	34,501,864	.29	38,434,738	.31
Counties	15,965,458	.20	20,869,867	.23	20,903,014	.22	23,892,718	.19
Municipalities	1,027,130	.32	2,126,985	.27	1,616,489	.29	2,232,786	.33
Other agencies	306,984	.73	2,407,977	.56	7,296,578	.42	11,000,205	.34
	39,316,452	.27	58,409,419	.31	64,317,945	.29	75,560,447	.28

Method of transport.—Shipments of sand and gravel originating on class I railroads in 1938 were 28,384,563 short tons, a drop of 24 percent from the 37,546,068 tons in 1937. This quantity was only 31 percent of the total commercial production reported in 1938, exclusive of glass and molding sand and nonrevenue railroad ballast. The figure indicates a continuing increase in the quantity of sand and gravel moved by other means than rail, as rail shipments were equivalent to 36 percent of commercial production in 1937 and 40 percent in 1936.

Direct reports of methods of transporting sand and gravel were received from producers responsible for 86 percent of the total commercial output. These figures not only show a decided drop in the relative magnitude of rail shipments but also a corresponding increase in shipments by truck and by waterway. Details of shipments, by methods of transport, follow.

Sand and gravel sold or used by commercial producers in the United States, 1937–38, by methods of transport [1]

Method of transport	1937		1938	
	Short tons	Percent of total reported	Short tons	Percent of total reported
Shipped by—				
Truck	42,829,073	39.3	39,142,876	43.0
Rail	51,612,774	47.4	37,675,155	41.3
Waterway	14,534,833	13.3	14,278,779	15.7
Total reported	108,976,680	100.0	91,096,810	100.0
Percent of total commercial production		86.9		86.1

[1] For practical purposes the entire output of noncommercial operations commonly is moved by truck. Including noncommercial production, sand and gravel moved as follows—1937: Truck 61 percent, rail 31 percent, and waterway 8 percent; 1938: Truck 69 percent, rail 23 percent, and waterway 8 percent.

Preparation.—The higher average value per ton of sand and gravel reported by commercial producers compared with noncommercial output is a direct result of the cost of washing, screening, or other preparation. In 1938, 88 percent of the commercial production was prepared material, but only 18 percent of the noncommercial output was treated.

Sand and gravel (prepared or unprepared) sold or used by producers in the United States, 1937–38, by commercial and noncommercial operations

	1937			1938		
	Short tons	Average value per ton	Percent of total	Short tons	Average value per ton	Percent of total
Commercial operations:						
Prepared	108,469,032	$0.68	87	92,825,363	$0.66	88
Unprepared	16,873,446	.31	13	12,934,423	.29	12
	125,342,478	.63	100	105,759,786	.61	100
Noncommercial operations:						
Prepared	12,376,800	.55	19	13,833,539	.49	18
Unprepared	51,941,145	.22	81	61,726,908	.23	82
	64,317,945	.29	100	75,560,447	.28	100
Grand total	189,660,423	.51		181,320,233	.47	

Size of plants.—Most sand and gravel plants are small. In 1938, 57 percent of all commercial plants reported sales of less than 25,000 tons each and 88 percent of less than 100,000 tons. These two groups produced 10 and 44 percent, respectively, of the total output. There has been a semblance of a trend toward smaller plants in the past few years, as 86 percent of the plants in 1931 reported less than 100,000 tons each and represented only 32 percent of the total tonnage. The following table gives details of production by size groups in 1937 and 1938.

Comparison of number and output of commercial sand and gravel plants in 1937 and 1938, by size groups [1]

Size groups in short tons	1937				1938			
	Plants [2]		Production		Plants [2]		Production	
	Number	Percent of total	Short tons	Percent of total	Number	Percent of total	Short tons	Percent of total
Less than 25,000	1,094	53.4	9,081,000	7.6	1,195	56.6	10,300,000	10.2
25,000 to 49,999	340	16.6	12,301,000	10.4	380	18.0	13,364,000	13.3
50,000 to 99,999	298	14.6	20,939,000	17.6	290	13.7	20,726,000	20.6
100,000 to 199,999	205	10.0	27,745,000	23.4	161	7.6	22,147,000	22.0
200,000 to 299,999	54	2.6	13,040,000	11.0	39	1.9	9,349,000	9.3
300,000 to 399,999	23	1.1	8,068,000	6.8	17	.8	5,774,000	5.7
400,000 to 499,999	9	.4	4,043,000	3.4	10	.5	4,406,000	4.4
500,000 to 599,999	5	.3	2,703,000	2.3	11	.5	5,892,000	5.8
600,000 to 699,999	9	.4	5,837,000	4.9	1	(3)	658,000	.6
700,000 to 799,999	5	.3	3,801,000	3.2	3	.1	2,123,000	2.1
800,000 to 899,999	2	.1	[4] 11,225,000	9.4	4	.2	[4] 4,382,000	4.3
900,000 to 999,999	-------	-------			1	(3)		
1,000,000 to 1,999,999	2	.1			1	.1	1,698,000	1.7
2,000,000 and over	2	.1			-------	-------	-------------	-------
	2,048	100.0	118,783,000	100.0	2,113	100.0	100,819,000	100.0

[1] Plants operated by or for States, counties, and municipalities are not included; also not included are 194 railroad plants with an output of 6,559,000 short tons of sand and gravel in 1937 and 186 plants with an output of 4,941,000 tons in 1938.
[2] May include a few companies operating more than 1 plant but not submitting separate returns for individual plants.
[3] Less than 0.1 percent.
[4] Combined to avoid revealing production of individual plants.

PRICES

Despite the drop in demand for sand and gravel for all important uses in 1938, prices changed little from those in 1937. The average value per ton, f. o. b. plant, of all sand and gravel reported by commercial producers fell only 3 percent—from $0.63 in 1937 to $0.61 in 1938. The sharpest decrease was in the value of filter sand and miscellaneous gravel, although engine and building sand as well as building and railroad ballast gravel also declined. The value of sand sold for various other purposes increased moderately, while that of paving gravel was unchanged.

Wholesale price indexes for sand and gravel, compiled by the Bureau of Labor Statistics from returns from about 30 plants throughout the United States, confirm the moderate decreases indicated by reports of producers to the Bureau of Mines. The price index of building sand (1926=100) declined only slightly, from 102.5 in 1937 to 102.1 in 1938, and that of gravel dropped from 94.2 to 93.2. These indexes are particularly significant when compared with other prices. The index for all building materials dropped from 95.2 in 1937 to 90.3 in 1938, and the general index for all commodities slumped from 86.3 to 78.6.

This relative stability of sand and gravel prices, despite declining prices for virtually all other commodities, was an outstanding feature of the industry in 1938.

NEW DEVELOPMENTS

Notwithstanding the drop in output in 1938, construction of new sand and gravel plants and remodeling of old plants through the installation of new equipment kept pace with 1937.[1] No outstandingly large plants were built in 1938; most of the new operations are designed to serve relatively small market areas, and some have facilities only for truck shipments. Many plants have been rebuilt, not so much to increase capacity or effect economies as to fill the demand for materials to meet new and changing specifications. As a matter of fact, the necessity for producing additional sizes of aggregates in many instances actually may have resulted in an increase in operating costs.[2] Several plants are now splitting their sand output into two or more size fractions and recombining them to meet varying specifications.

The National Sand and Gravel Research Foundation was established at the University of Maryland early in 1938. Modern equipment includes machines for strength tests of concrete and other materials, devices for abrasion tests of aggregates, a constant-temperature room, and other smaller equipment commonly found in construction-materials testing laboratories.

A preliminary study involving determination of the modulus of elasticity of concrete by sonic vibrations is being carried on in cooperation with the Eastern Experiment Station of the Bureau of Mines. This investigation may lead to a wider use of concrete in mine structures, will provide additional valuable information on the modulus of elasticity of concrete, and may point the way to further studies of the soundness of concrete and aggregates. Under way also are an investigation of the mortar-making characteristics of sand, continuation of the study of the adhesion of bitumens to aggregates, and a general study of the physical characteristics of miscellaneous aggregates.

FOREIGN TRADE [3]

Imports of sand and gravel increased in 1938, but, as in 1937, the entire gain was in the movement of construction materials from Canada. Imports of glass sand, virtually all from Belgium and consigned to the Pacific coast glass industry, decreased 34 percent.

Exports of sand and gravel dropped sharply, but the quantity of material involved is so small that they are of little consequence.

[1] Pit and Quarry, Sand and Gravel Benefits From Growing Construction Volume: Vol. 31, No. 7, January 1939, pp. 65-70

[2] Nordberg, Brov, Demands for New Products Require Plant Changes: Rock Products, vol. 42, No. 1, January 1939, pp. 38-41.

[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.

Sand and gravel imported for consumption in the United States, 1936–38, by classes

Class	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Glass sand [1]	52,944	$117,706	51,090	$79,112	33,889	$68,315
Other sand [2]	124,013	62,193	319,134	134,430	611,468	157,992
Gravel	201,398	38,142	163,406	36,193	55,619	22,902
	378,355	218,041	533,630	249,735	700,976	249,209

[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, 1936–38, by countries

Country	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
North America:						
Canada	322,091	$80,508	474,394	$142,828	655,742	$160,707
Mexico	22	5			22	220
Other North America			32	53		
Europe:						
Belgium	51,039	111,246	55,371	80,248	34,444	68,810
France	223	1,840	269	1,774	585	1,477
Germany	190	2,328	1,101	12,640	2,503	10,219
Netherlands	931	12,135	302	3,224	(1)	28
United Kingdom	3,859	9,979	1,655	8,506	7,572	6,827
Asia: Japan			2	12		
Oceania: Australia			504	450	108	921
	378,355	218,041	533,630	249,735	700,976	249,209

[1] Less than 1 ton.

Sand and gravel exported from the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	33,550	$41,649	1937	67,141	$80,197
1935	37,393	26,369	1938	35,572	30,303
1936	49,906	58,453			

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.

In 1938, for the first time, the National Slag Association canvassed 34 companies operating 70 plants engaged in preparing blast-furnace slag for market. The total output of air-cooled and granulated slag was 7,978,066 tons valued at $6,246,615. This quantity was equivalent to 14 percent of the total commercial-gravel production. The following tables give detailed statistics of blast-furnace slag sold or used by producers in the United States in 1938, by regions and by uses.

Blast-furnace slag sold or used by producers in the United States in 1938, by regions [1]

Region	Air-cooled			Granulated		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
A—New York, Pennsylvania, and Maryland	1,965,913	$1,837,954	$0.93	442,280	$43,731	$0.10
B—Kentucky, Ohio, and West Virginia	2,848,877	2,734,477	.96	214,527	34,992	.16
C—Tennessee and Alabama	1,945,217	1,219,924	.63			
D—Illinois, Indiana, and States west of the Mississippi	561,252	375,537	.67			
Total United States	7,321,259	6,167,892	.84	656,807	78,723	.12

[1] National Slag Association.

Blast-furnace slag sold or used by producers in the United States in 1938, by uses [1]

Use	Air-cooled			Granulated		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Concrete (roads, paving, building, etc.)	1,486,538	$1,326,647	$0.89			
Roads other than concrete	3,719,791	3,648,700	.98			
Fills, sub-bases, cushion courses, etc.	277,251	129,913	.47	624,753	$53,928	$0.09
Railroad ballast	1,510,279	795,467	.53			
Roofing	54,980	76,772	1.40			
Sewage trickle filter	35,687	38,613	1.08			
Agricultural purposes	6,002	3,600	.60	28,554	23,045	.81
Mineral wool	45,936	41,902	.91			
Screenings (use not given)	161,399	63,971	.40			
Other uses	23,396	42,307	1.81	3,500	1,750	.50
Total United States	7,321,259	6,167,892	.84	656,807	78,723	.12

[1] National Slag Association.

GYPSUM

By Forrest T. Moyer

SUMMARY OUTLINE

Activity in the gypsum industry was generally slower in 1938 than in 1937, as is illustrated by the 7-percent decrease in value of total sales of gypsum products. Although 1937 was the best year for the industry since 1932, depressing influences prevailing at its close carried over into the early part of 1938, and the progressive recovery during the second and third quarters of 1938 was little more than seasonal. Not until the fourth quarter was improvement definitely under way, and this was the only period in which sales of gypsum products gained over those in the corresponding quarter of 1937.

Of outstanding interest was the continued climb in sales of gypsum lath to a new high record. The present uptrend in consumption of this product began in 1935 and continued through 1938. It is significant that, as measured by the usual sales units (square feet for gypsum boards and short tons for plasters), lath is the only gypsum building product for which Bureau of Mines figures indicate an increase over 1937.

More active development of markets in the Southeastern States is indicated by the erection of processing mills by two gypsum companies. These mills, one in Georgia and one in Florida, began production of a complete line of gypsum products in the early part of 1939. They use crude gypsum imported from Canada. Formerly this area contained only two gypsum plants, one in Florida and the other in southwest Virginia. The large increase in productive capacity should promote larger consumption of gypsum products in the South.

The general welfare of the gypsum industry depends on building construction, which annually consumes more than 90 percent of the total value of all gypsum products sold or used in the country. As shown by data of the F. W. Dodge Corporation, the value of residential and nonresidential building contracts awarded in 1938 was virtually unchanged from that in 1937. Although building activity rose more or less steadily from the relatively low level that prevailed at the close of 1937, the gypsum industry in 1938 did not enjoy the full benefit of the indicated increase because of the lag of possibly 3 or 4 months between the time of contract award and the purchase of gypsum products. Consequently, much of the increased business forecast by the growing volume of building contracts during the latter part of 1938 did not reach the gypsum producer until the first half of 1939.

Salient statistics on the gypsum industry in the United States, 1934–38

	1934	1935	1936	1937	1938
Active establishments [1]	82	81	84	92	90
Crude gypsum:					
Mined ... short tons	1,536,170	1,903,880	2,712,510	3,058,166	2,684,205
Imported ... do	360,186	450,250	676,990	897,484	789,429
Apparent supply ... do	1,896,356	2,354,130	3,389,500	[2] 3,955,650	[2] 3,473,634
Calcined gypsum produced:					
Short tons	(3)	1,383,093	(3)	[4] 2,411,362	[4] 2,252,878
Value	(3)	(3)	(3)	[4] $11,076,205	[4] $10,989,626
Gypsum products sold: [5]					
Uncalcined:					
Short tons	578,947	595,130	830,683	[4] 860,825	[4] 756,565
Value	$1,266,945	$1,329,140	$1,865,673	[4] $1,920,706	[4] $1,681,371
Calcined:					
Short tons	1,140,590	1,552,968	2,210,338	[4 6] 2,643,075	[4] 2,556,296
Value	$16,184,459	$22,358,005	$31,088,885	[4 6] $36,879,814	[4] $34,574,937
Total value	$17,451,404	$23,687,145	$32,954,558	[4 6] $38,800,520	[4] $36,256,308
Gypsum and gypsum products:					
Imported for consumption	$414,377	$512,102	$718,378	$964,048	$832,357
Exported	$133,492	$186,196	$255,903	$271,142	$282,782

[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.
[6] Revised figures.

The accompanying table of salient statistics shows moderate declines for all phases of the gypsum industry in 1938 compared with 1937, except the limited export trade, which increased slightly in value. The drop from 1937 of 482,016 short tons (12 percent) in the apparent supply of crude gypsum was shared equally by domestic mines and importations. This proportional decrease in tonnage from both sources indicates the balanced relationship in 1938 between the utilized capacity of plants processing imported material and those using domestic crude. The decreases of 7 percent in the quantity of calcined gypsum produced (kettle and kiln output) and the value of all products sold or used, compared with 1937, give a more accurate picture of the condition of the industry in 1938 than that indicated by the greater decline in the crude supply. Sales of uncalcined products fell 12 percent below 1937 in both tonnage and value; but sales of calcined products, which constitute the major part of the gypsum business, declined only 3 percent in tonnage and 6 percent in value. This greater decrease in value was due to the lowering of the prices of several types of calcined gypsum products. The value of all gypsum and gypsum products imported during 1938 again exceeded the value of exports by approximately 3 to 1, chiefly because of the large tonnage of crude gypsum imported for processing into products.

DOMESTIC PRODUCTION

Domestic supplies of crude gypsum were obtained from 56 active operations including 28 underground mines, 22 quarries, and 6 combinations of underground mines and quarries. Operations were active in 16 States throughout the country; New York had the greatest number. As shown in the following table, production declined from 1937 in all of the States except Nevada and Montana where slight gains were recorded. Ranking States in order of tonnage were New York, Michigan, Iowa, and Texas. Underground mining, which is common practice in the East and Middle West, produced more than half the domestic crude supply in 1938.

Crude gypsum mined in the United States, 1936–38, by States

State	1936 [1]		1937			1938		
	Active mines	Short tons	Active mines	Short tons	Value	Active mines	Short tons	Value
California	5	142,853	5	186,158	$355,834	5	162,056	$334,208
Colorado	4	27,424	3	28,586	50,034	3	21,591	41,080
Iowa	8	344,221	8	387,255	533,162	8	364,920	495,856
Michigan	5	496,611	5	553,242	896,947	5	483,324	775,908
Nevada	3	167,342	3	160,347	268,638	3	168,515	366,869
New York	10	609,204	10	700,357	1,107,175	10	601,394	941,744
Oklahoma	4	156,545	4	159,639	266,091	3	141,341	231,910
Texas	5	257,773	5	280,807	313,563	5	246,990	260,094
Utah	3	40,275	3	46,197	46,197	3	43,144	45,823
Other States [2]	12	470,262	12	555,578	944,862	11	450,930	778,182
	59	2,712,510	58	3,058,166	4,782,503	56	2,684,205	4,271,674

[1] Value of crude gypsum mined not available.
[2] 1936–37: 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.

The value of the run-of-mine gypsum reported in the table is estimated by the producers, and as there is no open market for this material the figure is presumably a so-called "transfer value," which may represent only the actual cost of mining (including depreciation, depletion, etc.). In some instances the value returned by a producer may be only an estimate of a probable open-market price for the material. In 1938 the average value returned by producers was $1.59 per ton. The data on natural crude gypsum do not include the tonnage and value of crude byproduct gypsum utilized.

Number of active calcining plants, kettles, and rotary kilns in the United States, 1936–38, by States

State	1936			1937 [1]			1938 [1]		
	Calcining plants	Kettles	Rotary kilns	Calcining plants	Kettles	Rotary kilns	Calcining plants	Kettles	Rotary kilns
California	3	9		3	10		3	10	
Iowa	5	19		5	19		6	21	
Michigan	5	22		5	22		5	22	
New York	8	28	7	8	24	8	8	26	8
Texas	4	30		4	30		4	29	
Utah	3	[2] 9		3	6		3	[3] 8	
Other States [4]	23	[5] 62	9	26	[5] 72	10	25	[5] 67	8
	51	[2] [5] 179	16	54	[5] 183	18	54	[3] [5] 183	16

[1] Includes plants and equipment for calcining byproduct gypsum.
[2] Includes 3 vertical kilns.
[3] Includes 2 beehive kilns.
[4] 1936: 1 calcining plant each in Arizona, Connecticut, Indiana, Massachusetts, Nevada, New Hampshire, New Jersey, Pennsylvania, South Dakota, Vermont, and Wyoming; 2 each in Colorado, Kansas, Montana, Ohio, Oklahoma, and Virginia. 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.
[5] Includes 4 beehive kilns.

The foregoing table shows that calcining plants were operated in 25 States during 1938. There were 54 active plants, and of these 41 operated on domestic crude, 11 on imported, and 2 on crude byproduct gypsum. Two plants, one using domestic and the other using byproduct material, were abandoned in the latter part of the year.

DISTRIBUTION OF SALES

In 1938 sales of the three general groups of gypsum products—uncalcined, calcined building, and calcined industrial—declined in both quantity and value from 1937 figures. Gypsum sold for use as portland-cement retarder, which constitutes by far the greater part of all raw or uncalcined shipments, fell 12 percent in tonnage and 15 percent in value below 1937. The average value per ton (f. o. b. plant) for this material declined 6 cents from the 1937 figure to $1.84 per ton in 1938. Sales of agricultural gypsum, used chiefly by the peanut growers of Virginia and to correct alkali soils, declined more in quantity (9 percent) than in value (4 percent). A slight increase in the use of finely ground uncalcined products such as fillers is indicated by the rise in the average value per ton of sales for "Other uses" from $7.93 in 1937 to $8.84 in 1938.

Sales of calcined building products declined only 2 percent in quantity from 1937, because increases in the gross tonnages of gypsum-lath and wallboard sales nearly balanced the weight losses of plasters and tile. However, the total value of this group of products fell 6 percent below 1937, on account of decreases in the average value per unit of gauging, molding, and package plasters, as well as gypsum board. Plasters (fibered and unfibered) sold for use in base-coat work, which comprise the largest tonnage of calcined building products, declined 10 percent in quantity and 11 percent in value from 1937. In contrast, sales of gauging and molding plasters, which are used in the finishing coat, fell only 2 percent in tonnage but 6 percent in value from 1937. The greater proportional decline in tonnage of base-coat plasters may be explained by the increased use of gypsum lath on which there appears to be an unfortunate tendency to use thin scratch and brown coats or to eliminate entirely the brown coat. Sales of the class "Other plasters," which is composed largely of the so-called package plasters sold in small units, showed a large decline of $14.03 in the average value per ton from 1937. As shown in the following table, sales of the remaining classes of building plasters and Keene's cement declined various amounts from the 1937 figures. The rather high declines of 16 percent in both square footage and value of sales of all tile (partition, roofing, soffit, etc.) probably resulted from the relatively small total of commercial and industrial building during 1938.

Gypsum products made from domestic, imported, and byproduct crude gypsum sold or used in the United States, 1937–38, by uses

Use	1937		1938	
	Short tons	Value	Short tons	Value
Uncalcined:				
Portland cement retarder	770,004	$1,462,469	674,062	$1,238,715
Agricultural gypsum	74,932	332,248	68,470	318,620
Other uses [1]	15,889	125,989	14,033	124,036
Total uncalcined	860,825	1,920,706	756,565	1,681,371
Calcined:				
For building uses:				
Plasters:				
Base-coat	1,288,539	11,621,507	1,161,762	10,400,5[illegible]
Sanded	129,029	748,553	106,355	606,060
To mixing plants	24,532	144,565	16,917	102,821
Gauging and molding	123,292	1,527,764	120,933	1,442,511
Prepared finishes	29,291	568,404	26,424	488,307
Insulating and roof-deck	24,658	215,419	16,233	143,877
Other [2]	15,549	653,179	12,843	359,309
Keene's cement	[3] 34,260	[3] 530,863	23,496	366,813
Lath [4]	469,970	9,604,372	594,659	10,287,935
Wallboard [5]	241,096	8,349,810	269,949	7,921,400
Tile [6]	137,006	1,552,248	112,477	1,300,830
Total for building uses	[3] 2,517,222	[3] 35,516,684	2,462,048	33,420,420
For manufacturing uses:				
To plate-glass and terra-cotta works	60,620	466,803	21,918	144,845
To pottery works	19,415	254,532	16,981	219,071
Orthopedic and dental plasters	(7)	(7)	8,114	270,691
For other manufacturing uses [8]	45,818	641,795	47,235	519,910
Total for manufacturing uses	125,853	1,363,130	94,248	1,154,517
Total calcined	[3] 2,643,075	[3] 36,879,814	2,556,296	34,574,937
Grand total value		[3] 38,800,520		36,256,308

[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] Revised figures.
[4] 1937: 738,928,559 square feet; 1938: 809,470,931 square feet.
[5] 1937: 385,306,845 square feet; 1938: 371,766,937 square feet.
[6] 1937: 23,819,738 square feet; 1938: 19,941,993 square feet.
[7] Included under "For other manufacturing uses."
[8] Includes in 1937, orthopedic, dental, statuary, industrial molding and casting plasters, dead-burned filler, and miscellaneous sales; in 1938, statuary, industrial casting and molding plasters, dead-burned filler, and miscellaneous sales.

In 1938 total shipments of calcined products used in manufacturing processes declined 25 percent in quantity and 15 percent in value from 1937. The greatest decrease was in calcined gypsum sold to the plate-glass and terra-cotta industries and was occasioned by the low levels at which these industries operated until near the end of 1938.

The square footage of gypsum-lath sales rose to a new record during 1938, increasing 10 percent over 1937. This increase was accompanied by a decrease in unit value of 29 cents from 1937 to a sales value (f. o. b. plant) of $12.71 per thousand square feet in 1938. Both the square footage and total value of wallboard shipments dropped below 1937 figures, and the average value per thousand square feet decreased slightly. The gross tonnages of sales of both lath and wallboard, which are estimated by the producers, showed substantial gains over 1937. These gains indicate either an increase in average weight per thousand square feet or increased sales of the thicker sizes of both types of board. The average number of square feet per ton in 1938 was 1,361 for lath and 1,377 for wallboard as contrasted with corresponding figures for 1937 of 1,572 and 1,598.

Figure 1 shows the phenomenal expansion in sales of gypsum lath since 1928, the first year for which data are available. In the figure the square footage of lath and wallboard sold by selected companies and the total tonnage of all calcined gypsum building products are compared with the total floor area in square feet of all residential and nonresidential building contracts as reported by the F. W. Dodge Corporation. As these two general types of construction consume nearly all of the gypsum building products, their total floor area affords a reasonable basis for comparison. The sales of gypsum lath and wallboard by the selected companies represent approximately 90 and 95 percent respectively of the total annual sales of these products in the United States. The total tonnages of all calcined

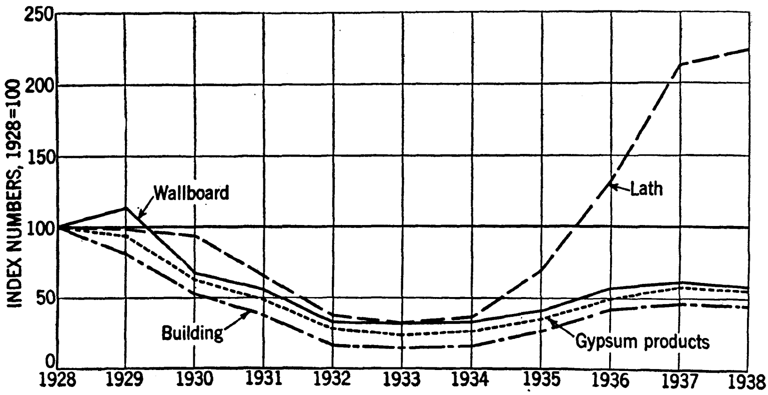

FIGURE 1.—Sales (square feet) of gypsum lath and wallboard by selected companies compared with total sales (short tons) of all calcined gypsum building products and total floor area (square feet) of residential and nonresidential building, 1928–38. Index numbers on building computed from F. W. Dodge Corporation data.

building products for 1937 and 1938 were adjusted for canvass changes so as to be comparable with preceding years.

The growing preference for gypsum lath over other types in the late twenties is shown clearly by the resistance in volume of sales of this product to the rapid decline in building activity after 1928. From 1931 to 1934 construction was virtually stagnant, and sales of lath followed the general trend of building. Beginning with 1935 gypsum lath became increasingly popular, and the volume of sales advanced rapidly. Thus, in 1938, when the total floor area of residential and nonresidential building was less than one-half the 1928 figure, the volume of sales of gypsum lath was 2¼ times greater than in 1928. The gain in 1938 over 1937 was smaller than that for the 2 preceding years but was accomplished despite a general decline in the volumes (measured as square feet for lath and wallboard, and short tons for plasters) of all other types of gypsum building products sold.

The great increase in sales of gypsum lath during 1935 and 1936 apparently resulted from a strong natural demand for lath, as the new price series of the Bureau of Labor Statistics shows that it developed without appreciable price reductions. The average wholesale price

(f. o. b. cars at destination) for standard ⅜-inch gypsum lath from 1928 to 1936 ranged between $17.18 and $18.19 per thousand square feet. A reduction to $15.87 per thousand square feet undoubtedly aided the expansion in lath sales during 1937, and a further drop in price to $15.23 per thousand square feet in 1938 was an added stimulus.

In contrast to the sales of gypsum lath, trend lines of the sales of wallboard and all gypsum building products have followed closely that of building. The great expansion in sales of lath would be expected to exert a greater influence on the total tonnage of all calcined building products than is shown in figure 1. Its failure to do so probably is caused by several factors. The first is that the quantity unit applied to lath is the square foot, and this unit is more accurate than the gross tonnages of lath, which represent mere estimates by the producers. Thus errors may be introduced in the change from one unit to another. The second is that the growing practice of using thinner plaster coats on gypsum lath than on the other types reduces for a given area the quantity of base-coat and ready-sanded plasters used and thus tends to counteract the increase in weight of lath sold. A third factor is the small but growing use of prefabricated finished wall surfaces, such as sheet-metal partitions, wood paneling, fiberboards, and plywood. This practice reduces the total wall area of building that normally requires the application of plasters and may have reduced consumption of gypsum plasters to such an extent as to counterbalance the increased weight of lath sold.

RECENT DEVELOPMENTS

In the latter part of 1938, construction was started on two new gypsum-processing plants, one in Georgia and the other in Florida. They will utilize imported crude rock. During the year three independent one-plant companies, one each in Kansas, New York, and Utah, were merged with large multiple-plant companies. Operations ceased at the New York plant, which was dismantled immediately after it was purchased. In Illinois a plant using crude byproduct gypsum was closed permanently. A large producer of building materials entered the gypsum industry during the year, gaining control of an independent company in Ohio and obtaining an excess-capacity agreement with one of the principal gypsum producers.

Fresh interest was aroused in the drying and grinding of crude gypsum as a single operation when a hammer-type mill designed for this purpose was installed in one of the new processing plants under construction in the Southeast. It is understood that at least one producing company is experimenting with the drying, grinding, and calcining of gypsum as a single operation in a hammer-type mill. This process would eliminate two of the three steps that are necessary with the conventional equipment of gypsum-processing plants.

An outstanding development during 1938 was the introduction of a patented machine that will perforate gypsum lath by punching the holes through a single thickness of board. The machine, which operates continuously, is said to yield the best results when perforating lath directly before the cutting knife. If the operation is as successful as reported for the first installations, the standard method of bundling the lath and drilling the holes with a battery of augers probably will be replaced within a short time.

Results of a comprehensive study [1] of the heats of hydration and the transitions of the various forms of calcium sulfate were published by the Bureau of Standards. Investigations [2] by the same organization on the suitability of several types of lath as plaster bases and on the methods of plaster application are of interest to gypsum producers.

The Bureau of Mines published a description [3] of the occurrence, mining, and processing of gypsum in the United States. The report includes general information on anhydrite, which is closely related to gypsum.

FOREIGN TRADE [4]

Imports.—The bulk of the imports of gypsum consists of crude rock, which enters the United States at certain New England, Middle Atlantic, Florida, and California ports. Although this material has a low average value per ton ($0.98 c. i. f. shipping port), such large quantities are imported that its total value comprised 93 percent of the total value of gypsum imports in 1938. Approximately 90 percent of the crude tonnage imported is processed into finished calcined-gypsum products at plants on tidewater near centers of consumption. Of the remaining tonnage, slightly more than half is ground and sold as agricultural gypsum, and the balance is consumed chiefly as retarder for portland cement.

The total value (c. i. f. shipping port) of gypsum imports during 1938 declined nearly 14 percent compared with 1937. All classes exhibited decreases of varying proportions except calcined, which increased slightly in tonnage and decreased in value. Crude gypsum imported during 1938 decreased 12 percent in quantity and 10 percent in value from 1937. Of the tonnage of crude material imported in 1938, tidewater quarries in Nova Scotia and New Brunswick, Canada, furnished 94 percent, and nearly all of the remainder came from San Marcos Island, Baja California, Mexico. The small tonnage from Italy evidently was composed largely of blocks of alabaster, which is used for carving art objects. The following tables show imports of gypsum and gypsum products in recent years.

Gypsum imported for consumption in the United States, 1934–38

Year	Crude		Ground		Calcined		Other manufactures n. e. s.	Keene's cement		Total value
	Short tons	Value	Short tons	Value	Short tons	Value		Short tons	Value	
1934	360,186	$371,082	1,085	$14,880	534	$10,890	$16,859	27	$666	$414,377
1935	450,250	463,050	1,241	15,440	601	11,364	20,958	64	1,290	512,102
1936	[1] 676,990	[1] 657,125	1,374	16,937	450	8,778	34,722	20	816	718,378
1937	[1] 897,484	[1] 854,835	1,711	22,165	353	7,917	78,456	25	675	964,048
1938	[1] 789,429	[1] 772,026	1,486	17,674	372	7,649	34,878	6	130	832,357

[1] Includes anhydrite.

[1] Newman, E. S., and Wells, L. S., Heats of Hydration and Transition of Calcium Sulfate: Nat. Bureau of Standards, Jour. Research, vol. 20, No. 6, 1938, pp. 825–836.

[2] Wells, L. S., and Smith, D. C., Suitability of Fiber Insulating Lath as a Plaster Base: Nat. Bureau of Standards, Rept. BMS 3, 1938, 17 pp.

[3] Moyer, F. T., Gypsum and Anhydrite: Bureau of Mines Inf. Circ. 7049, 1939, 45 pp.

[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.

Crude gypsum (including anhydrite) imported for consumption in the United States, 1936–38, by countries

Country	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Canada	631,340	$613,052	838,106	$797,157	739,172	$723,780
Hong Kong	1	24				
Italy	185	3,879	207	4,337	124	2,943
Mexico	45,464	40,170	59,166	53,146	50,133	45,303
United Kingdom			5	195		
	676,990	657,125	897,484	854,835	789,429	772,026

Exports.—The total value of all gypsum and gypsum products exported from the United States in 1938 increased slightly over that in 1937. The following table shows that decreased shipments of raw gypsum and gypsum board were more than balanced by increases in the other classes of gypsum products exported.

Gypsum and gypsum products exported from the United States, 1934–38

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		
1934	2,588	$11,652	1,895,700	$43,041	[1] 2,264	[1] $78,799	(2)	$133,492
1935	4,528	15,473	1,929,348	42,465	[1] 4,717	[1] 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

[1] Includes "Other manufactures, n. e. s."
[2] Not separately classified previous to 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.

The formation [5] of a Government-controlled company to produce gypsum board at Riga, Latvia, is of interest to the export trade. This plant, with an average guaranteed capacity of 1,500,000 square feet of board per year, is said to be the first of its kind in continental Europe. The entire production is to be exported.

WORLD PRODUCTION

The following table shows the world output of crude gypsum from 1934 to 1938, inclusive, insofar as data are available. The leading producing countries, in probable order of importance, are the United States, France, United Kingdom, Canada, Germany, and the U. S. S. R.

[5] National Bureau of Foreign and Domestic Commerce, Foreign Metals and Minerals: Circ. 18, October 12, 1938, p. 27.

World production of gypsum, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
Algeria	83,920	56,710	45,265	46,175	(2)
Anglo-Egyptian Sudan			2,997		(2)
Argentina [3]	44,142	49,773	55,706	(4)	(2)
Australia:					
New South Wales	2,753	1,722	4,390	9,300	(2)
South Australia	76,449	103,909	108,871	117,985	(2)
Victoria	6,499	8,852	7,581	21,197	(2)
Western Australia	5,392	5,450	6,768	9,219	(2)
Brazil [5]	2,000	2,000	2,000	2,000	2,000
Canada	447,507	510,262	763,044	1,044,231	(6)
Chile	10,901	26,151	22,674	24,080	(2)
China	67,720	68,000	68,800	(4)	(2)
Cyprus [7]	9,217	14,851	16,603	13,576	9,729
Egypt	149,713	190,666	256,211	253,641	(2)
Eire			6,096	11,647	(2)
Estonia	4,905	6,238	13,849	12,748	(2)
France	1,453,450	1,275,000	1,376,150	1,320,400	(2)
Germany [8]	810,000	855,000	(4)	(4)	(2)
Austria [9]	45,000	46,000	47,000	47,000	(2)
Greece	4,525	3,612	13,779	17,924	(2)
India, British	47,507	46,045	55,277	46,830	(2)
Italy	458,978	471,167	324,789	416,198	(2)
Japan	(4)	127,633	137,677	(4)	(2)
Latvia [7]	81,816	98,935	123,503	196,911	196,964
Luxemburg	10,689	29,474	29,110	19,722	(2)
Mexico	(4)	54,514	61,711	(4)	(2)
New Caledonia	13,585			984	(2)
Palestine	3,431	4,543	6,209	3,934	3,984
Peru	8,147	9,056	12,560	15,000	(2)
Portugal	20,315	4,800	6,850	11,390	(2)
Rumania	47,176	62,018	45,991	53,603	(2)
Spain	741,245	(4)	(4)	(4)	(2)
Sweden	121	170	93	(4)	(2)
Tunisia	15,550	11,000	11,200	22,800	(2)
Union of South Africa	23,296	21,590	31,962	33,186	(2)
U. S. S. R.	688,000	(4)	(4)	(4)	(4)
United Kingdom	977,014	997,673	1,018,562	1,111,669	(2)
United States	1,393,583	1,727,162	2,460,735	2,774,307	2,435,057
	7,900,000	8,300,000	9,400,000	10,300,000	(2)

[1] In addition to the countries listed, gypsum is produced in Cuba, Switzerland, and Yugoslavia, but production data are not available.
[2] Data not yet available.
[3] Rail and river shipments.
[4] Data not available; estimate included in total.
[5] Approximate production.
[6] Data for crude gypsum mined not available. Shipments of crude (lump, crushed, and ground) and calcined gypsum amounted to 924,587 tons.
[7] Exports of crude and calcined gypsum.
[8] Figures supplied by Deutscher Gips-Verein, E. V., Berlin, Germany. Figures are exclusive of rock gypsum mined and used by cement, paint, and other factories from their own quarries.
[9] Estimate furnished by Bundesministerium für Handel und Verkehr.

LIME

By Forrest T. Moyer and A. T. Coons

SUMMARY OUTLINE

The total quantity of lime (quick and hydrated) sold or used in the United States in 1938 was 19 percent lower than in 1937. Activity, which corresponded closely with average business conditions throughout the country, was depressed during the first half of the year but improved greatly in all branches of the industry during the latter half. However, these gains were insufficient to compensate for the earlier losses. The decrease in sales was accompanied by a slight decline in prices of nearly all types of lime. Sales of hydrated lime held up considerably better than those of quicklime, which fell 23 percent below 1937.

As reported by the operators, wages remained at approximately the same level as in 1937, although small local increases were noted. Labor difficulties, of which the most serious closed several large plants in the Middle West for nearly 6 months, occurred in scattered localities.

Because demand for all types of lime was low during the early months, total sales by general groups of uses in 1938 reflect the varying degrees of improvement that occurred in the consuming industries later in the year. The downtrend in building construction was among the first to be reversed, and activity in this industry increased steadily after the first quarter of the year. Dollar volume of contracts awarded for residential building, as reported by the F. W. Dodge Corporation, was nearly trebled from February to August and remained at a high level through December. Increased building of residences was aided to a large extent by the liberal mortgage-insurance policy of the Federal Housing Administration, which transacted a record volume of business. Likewise, the value of nonresidential building at the close of the year was nearly three times as great as it was in February. The subsidized-housing program of the Federal Government (United States Housing Authority), which was barely under way at the end of 1938, will be an important factor in the building industry during the first half of 1939. Despite the increase in contracts awarded, sales of building lime in 1938 were 10 percent below 1937. The failure of lime to keep pace with the increase in building is doubtless due partly to the fact that many contracts awarded toward the close of the year did not reach the actual construction stage until early in 1939. Furthermore, there is always a lag of 1 to 3 months between the time of contract award and the purchase of lime.

In close accord with the 11-percent decline in the total cash farm income in 1938, sales of agricultural lime in 1938 were 10 percent below those in 1937. Both lime and limestone are used on agricultural land, but the claim is made that lime, particularly in hydrated form, affords a closer control of acidity or alkalinity in the soil than unburned stone.

Salient statistics of the lime industry in the United States, 1937–38

	1937	1938	Percent of change in 1938
Lime sold or used by producers:			
Total lime:			
Short tons	4,124,165	3,346,954	−18.8
Value	$30,091,168	$24,137,638	−19.8
Per ton	$7.30	$7.21	−1.2
Hydrated lime (included in total):			
Short tons	1,301,333	1,169,804	−10.1
Value	$10,344,470	$9,111,575	−11.9
Per ton	$7.95	$7.79	−2.0
By uses:			
For building:			
Short tons	948,553	854,461	−9.9
Value	$8,212,995	$7,163,165	−12.8
Per ton	$8.66	$8.38	−3.2
For agriculture:			
Short tons	406,462	364,312	−10.4
Value	$2,738,433	$2,376,108	−13.2
Per ton	$6.74	$6.52	−3.3
For chemical uses (excluding dead-burned dolomite):			
Short tons	2,151,444	1,761,555	−18.1
Value	$13,921,907	$11,503,010	−17.4
Per ton	$6.47	$6.53	+.9
Dead-burned dolomite:			
Short tons	617,706	366,626	−40.6
Value	$5,217,833	$3,095,355	−40.7
Per ton	$8.45	$8.44	−.1
Imports for consumption:			
Quicklime and hydrated lime:			
Short tons	8,788	6,818	−22.4
Value	$90,605	$66,203	−26.9
Per ton	$10.31	$9.71	−5.8
Dead-burned dolomite:			
Short tons	9,083	2,875	−68.3
Value	$231,084	$67,340	−70.9
Per ton	$25.44	$23.42	−7.9
Exports (lime):			
Short tons	11,300	13,222	+17.0
Value	$122,895	$121,662	−1.0
Per ton	$10.88	$9.20	−15.4

Chemical uses of lime, as grouped by the Bureau of Mines, consumed 389,889 short tons less in 1938 than in 1937, a decline of 18 percent. Sales to the principal consuming industries of this group generally decreased from those in 1937 in varying proportions. An increase was noted only in sugar refining, which consumes a relatively small tonnage. The quantity of metallurgical lime sold or used showed the greatest decline—29 percent below 1937. This drop in consumption resulted chiefly from the low average levels of activity in the steel and copper industries. Nearly three-fourths of the total tonnage of metallurgical lime is used in making steel ingots, production of which in 1938, according to Federal Reserve Board data, was only 67 percent of the 1923–25 annual average contrasted with 119 percent in 1937. Approximately half of the remaining tonnage is consumed in the flotation of copper ores, and the total quantity of such ores treated in 1938 was lower than in 1937.

Sales of lime to the paper industry, the second largest consumer of chemical-grade lime, were 10 percent below 1937, reflecting a corresponding decrease in the total volume of all major types of paper produced. A substantial decline in plate-glass and glass-container production in 1938 was accompanied by a decrease of 24 percent in the quantity of lime used in glass manufacture.

In 1938 sales of dead-burned dolomite, for the first time since 1932, failed to show a gain over the preceding year and were 41 percent below the record volume of 1937. The tonnage decrease of this material, which is used mainly for open-hearth refractories, resulted from the low percentage of capacity at which steel plants operated during the year. Moreover, as implied by the record consumption in 1937, the furnaces probably were in good condition and required a minimum of repairs to the refractory linings. In this chapter data on dead-burned dolomite do not include the entire consumption in the United States, as some steel companies calcine dolomite purchased raw or obtained from their own quarries. Such tonnages, recorded in the chapter on Stone in this volume, decreased 54 percent from 1937.

For the first year since 1919 the total value of lime exports in 1938 nearly balanced the total value of imports for consumption. However, the export-import trade represents only a small fraction of the total lime business.

PRODUCTION

The recovery of the lime industry from the economic depression of the early 1930's progressed steadily from 1932 to 1937, total sales in each year increasing over those of the preceding year in both quantity and value. In 1938, however, this upward movement was halted, and lime consumption fell below that of 1936. Data covering recent years are given in the following table.

Lime sold or used by producers in the United States, 1934–38

Year	Plants in operation	Short tons [1]	Value [2]	
			Total [1]	Average
1934	324	2,397,087	$17,164,024	$7.16
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

[1] Includes lime used by producers (captive tonnage) as follows—1934: 129,290 short tons valued at $671,864; 1935: 143,716 tons, $750,155; 1936: 224,693 tons, $1,179,820; 1937: 270,192 tons, $1,388,052; 1938: 168,245 tons, $985,003.

[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.—As the following table shows, production of lime in most States was lower in 1938 than in 1937; the largest declines occurred in Missouri and West Virginia. Increased output was noted for several States, the largest being in Indiana, Maryland, and Tennessee. The production of lime in 1938 in the three leading States—Ohio, Pennsylvania, and Missouri—comprised 50 percent of the total output of the country.

Lime sold or used by producers in the United States, 1937–38, by States

State	1937			1938		
	Plants in operation	Short tons	Value	Plants in operation	Short tons	Value
Alabama	8	176,085	$964,400	9	151,937	$911,033
Arizona	3	54,789	466,098	3	39,568	353,224
Arkansas	2	(1)	(1)	2	(1)	(1)
California	7	71,965	737,387	7	71,596	712,388
Colorado	4	7,163	72,831	3	9,564	95,207
Connecticut	1	(1)	(1)	1	(1)	(1)
Florida	3	19,008	177,929	3	19,638	185,286
Georgia	1	7,964	62,196	1	7,046	54,150
Hawaii	1	8,261	83,183	2	(1)	(1)
Idaho	1	(1)	(1)	1	(1)	(1)
Illinois	7	142,122	1,039,087	8	135,256	965,836
Indiana	7	94,053	552,243	6	102,054	581,922
Kentucky	1	(1)	(1)	1	(1)	(1)
Maine	2	(1)	(1)	2	(1)	(1)
Maryland	11	59,575	404,562	19	62,479	446,013
Massachusetts	6	101,247	897,356	6	91,453	741,975
Michigan	4	48,310	351,681	4	45,848	339,324
Minnesota	2	(1)	(1)	2	(1)	(1)
Missouri	10	426,514	2,326,928	10	298,151	1,724,140
Montana	3	13,295	79,201	2	(1)	(1)
Nevada	2	(1)	(1)	2	(1)	(1)
New Jersey	4	20,029	151,350	4	19,940	145,076
New Mexico	3	902	8,900	2	(1)	(1)
New York	9	55,947	438,151	8	39,439	302,360
North Carolina	1	(1)	(1)	1	(1)	(1)
Ohio	22	1,069,374	8,653,571	22	836,589	6,658,853
Oklahoma				1	(1)	(1)
Oregon	2	(1)	(1)	2	(1)	(1)
Pennsylvania	95	692,935	5,117,733	99	532,066	3,784,462
Puerto Rico	4	4,723	39,909	3	2,953	23,554
Rhode Island	1	(1)	(1)	1	(1)	(1)
South Carolina	1	(1)	(1)			
South Dakota	2	(1)	(1)	2	(1)	(1)
Tennessee	10	157,440	909,839	10	162,661	901,460
Texas	7	49,135	440,069	7	49,352	429,664
Utah	9	46,670	319,517	7	25,748	184,390
Vermont	5	56,585	388,885	5	58,149	415,846
Virginia	24	192,493	1,248,479	24	161,687	1,014,607
Washington	5	65,272	647,692	5	34,025	348,332
West Virginia	12	250,205	1,617,040	12	163,064	1,003,559
Wisconsin	12	59,536	508,536	12	55,993	483,111
Undistributed		172,568	1,386,415		170,698	1,331,866
	314	4,124,165	30,091,168	321	3,346,954	24,137,638

1 Included under "Undistributed."

Hydrated lime.—Despite a drop in the average value per ton, the quantity of hydrated lime sold or used in 1938 declined 10 percent from 1937. This was the first year since 1934 in which sales were less than in the preceding year. The accompanying table presents data from 1934 to 1938, inclusive.

Hydrated lime sold or used by producers in the United States, 1934–38

Year	Plants in operation	Short tons	Value	
			Total	Average
1934	165	829,430	$6,324,623	$7.63
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

As the following table indicates, production of hydrated lime in 1938 was smaller than in 1937 in most States. The sharp decline of 24 percent in Missouri probably was due to a prolonged strike, which closed several large plants. Production increased in only a few States, California showing the largest proportional gain—19 percent. Ohio and Pennsylvania continued to be the leading producing States, and their combined output was 49 percent of the total for the country.

Hydrated lime sold or used by producers in the United States, 1937–38, by States

State	1937		1938	
	Short tons	Value	Short tons	Value
Alabama	23,884	$167,292	26,266	$190,567
California	13,627	152,036	16,255	170,990
Florida	10,803	103,998	9,952	95,784
Georgia	7,881	61,331	7,046	54,150
Illinois	24,625	191,100	24,598	189,937
Indiana	31,470	201,970	32,845	206,290
Maryland	33,419	237,730	31,124	229,053
Massachusetts	35,271	264,247	34,111	233,748
Michigan	10,688	84,747	10,035	82,340
Missouri	121,321	769,400	92,090	602,472
New York	16,948	136,026	14,299	110,870
Ohio	437,925	3,678,118	391,364	3,247,112
Pennsylvania	212,513	1,751,086	178,180	1,363,343
Tennessee	41,892	324,207	44,336	331,734
Texas	24,415	226,271	24,264	235,445
Virginia	59,067	439,697	52,683	368,290
West Virginia	47,544	349,033	43,776	290,095
Wisconsin	14,257	111,090	13,814	112,086
Undistributed [1]	133,783	1,095,091	122,766	997,269
	1,301,333	10,344,470	1,169,804	9,111,575

[1] Includes Arizona, Arkansas, Colorado, Connecticut, Hawaii, Kentucky, Maine, Minnesota, Montana, Nevada, New Jersey, North Carolina, Oregon, Rhode Island, South Dakota, Utah, Vermont, and Washington.

SHIPMENTS

Total shipments.—Sales, shipments, and supplies of lime available for consumption by States in continental United States are given in the accompanying table. Reshipments beyond the original destinations from the producing plants are disregarded. Pennsylvania, with its great variety of industries, ranks first by a large margin in apparent consumption of both quick and hydrated lime. Other States, in order of tonnage of quicklime consumed in 1938, were Ohio, West Virginia, and Illinois, and of hydrated lime, New York, Ohio, and New Jersey. A greater tonnage of lime was shipped from Ohio than from any other State, and more lime was shipped into New York for consumption than into any other State.

Lime supplies available for consumption in continental United States in 1938, by States, in short tons

State	Sales by producers	Shipments from State	Shipments into State	Supply			
				Hydrated	Quicklime	Total	Pounds per capita [1]
Alabama	151,937	51,637	18,823	14,103	105,020	119,123	82
Arizona	39,568	14,475	832	1,542	24,383	25,925	126
Arkansas	(2)	(2)	(2)	4,665	9,704	14,369	14
California	71,596	8,776	23,950	21,844	64,926	86,770	28
Colorado	9,564	187	5,528	3,162	11,743	14,905	28
Connecticut	(2)	(2)	(2)	10,525	14,810	25,335	29
Delaware			31,905	13,269	18,636	31,905	244
District of Columbia			14,945	14,092	853	14,945	48
Florida	19,638		23,764	23,185	20,217	43,402	52
Georgia	7,046	1,046	38,886	26,741	18,145	44,886	29
Idaho	(2)		(2)	980	1,491	2,471	10
Illinois	135,256	54,976	131,933	64,999	147,214	212,213	54
Indiana	102,054	72,868	71,136	32,372	67,950	100,322	58
Iowa			40,110	15,092	25,018	40,110	31
Kansas			20,138	10,714	9,424	20,138	22
Kentucky	(2)		(2)	15,045	34,355	49,400	34
Louisiana			55,085	11,085	44,000	55,085	52
Maine	(2)	(2)	(2)	9,243	50,022	59,265	138
Maryland	62,479	18,382	65,679	52,295	57,481	109,776	131
Massachusetts	91,453	69,338	34,850	25,423	31,542	56,965	26
Michigan	45,848	22,803	128,043	53,564	97,524	151,088	63
Minnesota	(2)	(2)	(2)	12,354	20,806	33,160	25
Mississippi			16,585	3,655	12,930	16,585	16
Missouri	298,151	251,075	25,058	31,733	40,401	72,134	36
Montana	(2)	(2)	(2)	3,482	6,740	10,222	38
Nebraska			7,771	6,651	1,120	7,771	11
Nevada	(2)	(2)	(2)	18,774	2,564	21,338	423
New Hampshire			7,389	2,755	4,634	7,389	29
New Jersey	19,940	5,063	99,442	84,124	30,195	114,319	53
New Mexico	(2)		(2)	1,111	5,919	7,030	33
New York	39,439	5,266	205,633	127,310	112,496	239,806	37
North Carolina	(2)	(2)	(2)	29,596	17,381	46,977	27
North Dakota			5,317	5,203	114	5,317	15
Ohio	836,589	592,107	97,456	93,996	247,942	341,938	102
Oklahoma	(2)	(2)	(2)	7,896	13,787	21,683	17
Oregon	(2)	(2)	(2)	2,484	6,073	8,557	17
Pennsylvania	532,066	196,742	172,415	144,226	363,513	507,739	100
Rhode Island	(2)	(2)	(2)	5,802	3,693	9,495	28
South Carolina			21,345	12,929	8,416	21,345	23
South Dakota	(2)		(2)	2,428	4,213	6,641	19
Tennessee	162,661	115,033	8,263	22,907	32,984	55,891	39
Texas	49,352	5,269	6,983	26,070	24,996	51,066	17
Utah	25,748	416	595	3,173	22,754	25,927	100
Vermont	58,149	51,692	662	1,062	6,057	7,119	37
Virginia	161,687	113,974	52,857	36,862	63,708	100,570	74
Washington	34,025	7,859	1,719	4,116	23,769	27,885	34
West Virginia	163,064	141,404	169,801	18,882	172,579	191,461	205
Wisconsin	55,993	19,515	48,983	22,504	62,957	85,461	58
Wyoming			1,681	872	809	1,681	14
Undistributed	164,060	68,195	220,078				
	3,337,363	[3] 1,888,098	1,875,640	1,156,897	2,168,008	3,324,905	51

[1] Based on latest figures of Bureau of Census.
[2] Included under "Undistributed."
[3] Includes 12,458 short tons of lime exported or unspecified by producers as to destination.

The origin and destination of hydrated, quick, and total lime shipments for 1937 and 1938, by groups of States that comprise approximate freight zones, are listed in the following tables. These data do not include a small quantity of lime (about 1 percent of the total) consisting of Hawaiian and Puerto Rican production, foreign shipments, and tonnage for which distribution is not recorded. Reshipments beyond the original destinations from the producing plants are not considered.

Lime shipped (supply) in continental United States, 1937–38, 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 [1]			Alabama, Kentucky, Tennessee		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
1937															
Illinois, Indiana, Michigan, Ohio	241,545	531,735	773,280	5,102	49,665	54,767	173	-------	173	815	4,457	5,272	1,457	3,236	4,693
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	153,986	234,981	388,967	311,039	646,009	957,048	28,214	54,693	82,907	17,082	87,858	104,940	2,910	2,662	5,572
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	19,015	1,011	20,026	2,593	30,245	32,838	41,257	85,215	126,472	-------	6,266	6,266	-------	-------	-------
Florida, Georgia, North Carolina, South Carolina, Virginia	37,730	3,293	41,023	9,280	20,017	29,297	-------	75	75	59,693	46,256	105,949	27,763	71,728	99,491
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	18,872	30,078	48,950	450	217	667	-------	-------	-------	555	75	630	34,255	189,601	223,856
Arkansas, Kansas, Nebraska, Oklahoma, Texas	2,649	573	3,222	-------	-------	-------	-------	-------	-------	-------	7	7	16	812	828
Iowa, Minnesota, Missouri, Wisconsin	29,008	42,916	71,924	5	31	36	-------	-------	-------	-------	31	31	-------	-------	-------
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,816	2,255	4,071	1	2	3	-------	-------	-------	-------	-------	-------	130	220	350
1938															
Illinois, Indiana, Michigan, Ohio	212,455	419,094	631,549	3,644	30,713	34,357	-------	-------	-------	1,373	6,728	8,101	1,192	15,171	16,363
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	138,193	164,958	303,151	272,945	450,336	723,281	22,914	43,449	66,363	13,244	66,851	80,095	2,416	12,743	15,159
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	17,316	621	17,937	1,471	25,919	27,390	35,767	82,090	117,857	256	1,752	2,008	-------	-------	-------
Florida, Georgia, North Carolina, South Carolina, Virginia	36,941	2,356	39,297	7,811	20,731	28,542	-------	44	44	54,465	44,559	99,024	29,021	58,785	87,806
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	20,295	25,903	46,198	132	538	670	-------	-------	-------	455	-------	455	37,133	156,562	193,695
Arkansas, Kansas, Nebraska, Oklahoma, Texas	3,057	2,185	5,242	20	-------	20	-------	-------	-------	-------	-------	-------	70	840	910
Iowa, Minnesota, Missouri, Wisconsin	28,271	42,146	70,417	25	138	163	11	-------	11	5	-------	5	786	-------	786
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	1,961	2,148	4,109	-------	-------	-------	-------	-------	-------	-------	-------	-------	130	110	240

[1] Includes South Carolina in 1937.

Lime shipped (supply) in continental United States, 1937–38, by origin and destination of shipments, in short tons—Continued

Destination	Arkansas and Texas [2]			Minnesota, Missouri, Wisconsin			Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington			United States		
	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total	Hydrated lime	Quicklime	Total
1937												
Illinois, Indiana, Michigan, Ohio	-	-	-	33,356	150,034	183,390	-	-	-	282,448	739,127	1,021,575
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	-	2	2	7,626	28,922	36,548	-	-	-	520,857	1,055,127	1,575,984
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-	-	-	74	197	271	-	-	-	62,939	122,934	185,873
Florida, Georgia, North Carolina, South Carolina, Virginia	-	-	-	1,902	3,355	5,257	-	-	-	136,368	144,724	281,092
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	4,187	15,625	19,812	4,687	19,895	24,582	-	-	-	63,006	255,491	318,497
Arkansas, Kansas, Nebraska, Oklahoma, Texas	30,165	34,255	64,420	20,471	18,433	38,904	-	100	100	53,301	54,180	107,481
Iowa, Minnesota, Missouri, Wisconsin	382	330	712	63,343	142,013	205,356	-	-	-	92,738	185,321	278,059
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	783	740	1,523	13,640	7,508	21,148	62,272	243,259	305,531	78,642	253,984	332,626
1938												
Illinois, Indiana, Michigan, Ohio	115	-	115	26,152	88,924	115,076	-	-	-	244,931	560,630	805,561
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	26	50	76	4,856	28,429	33,285	-	-	-	454,594	766,816	1,221,410
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	-	-	-	-	376	376	-	-	-	54,810	110,758	165,568
Florida, Georgia, North Carolina, South Carolina, Virginia	-	-	-	1,075	1,392	2,467	-	-	-	129,313	127,867	257,180
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	5,020	18,182	23,202	3,364	17,041	20,405	-	-	-	66,399	218,226	284,625
Arkansas, Kansas, Nebraska, Oklahoma, Texas	35,244	38,781	74,025	17,605	17,225	34,830	-	-	-	55,996	59,031	115,027
Iowa, Minnesota, Missouri, Wisconsin	754	281	1,035	51,831	106,617	158,448	-	-	-	81,683	149,182	230,865
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	252	184	436	10,447	6,936	17,383	56,381	166,120	222,501	69,171	175,498	244,669

[2] Includes Oklahoma in 1938.

The following table shows the relatively small quantities of lime shipped from continental United States to various island Territories.

Lime shipped to noncontiguous Territories of the United States, 1937–38

Territory	1937		1938	
	Short tons	Value	Short tons	Value
American Samoa			(1)	$7
Hawaii	666	$11,212	1,770	26,071
Puerto Rico	1,024	13,638	895	9,643
Virgin Islands	188	3,947	97	1,902
Wake Island	(1)	3		
	1,878	28,800	2,762	37,623

[1] Less than 1 ton.

Hydrated lime.—The following table shows total shipments of hydrated lime into various groups of States in 1937 and 1938. The largest apparent consumption is in the Middle Atlantic States, with their densely populated industrial centers. Distribution of hydrated lime from Ohio plants to the same groups of States are shown separately in the table.

Shipments of hydrated lime from plants in continental United States and in Ohio, 1937–38, by destinations

Destination	From all plants		From Ohio plants		
	Short tons	Distribution (percent)	Short tons	Distribution (percent)	District total (percent)
1937					
Illinois, Indiana, Michigan, Ohio	282,448	21.8	191,331	43.7	67.7
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	520,857	40.3	153,320	35.0	29.4
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	62,939	4.9	19,015	4.3	30.2
Florida, Georgia, North Carolina, South Carolina, Virginia	136,368	10.5	37,709	8.6	27.7
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	63,006	4.9	15,872	3.6	25.2
Arkansas, Kansas, Nebraska, Oklahoma, Texas	53,301	4.1	2,528	.6	4.7
Iowa, Minnesota, Missouri, Wisconsin	92,738	7.2	16,923	3.9	18.2
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	78,642	6.1	1,140	.3	1.4
Undistributed and exports	2,791	.2	87	(1)	3.1
	1,293,090	100.0	437,925	100.0	33.9
1938					
Illinois, Indiana, Michigan, Ohio	244,931	21.1	162,261	41.5	66.2
Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania, West Virginia	454,594	39.1	137,298	35.1	30.2
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	54,810	4.7	17,200	4.4	31.4
Florida, Georgia, North Carolina, South Carolina, Virginia	129,313	11.1	36,881	9.4	28.5
Alabama, Kentucky, Louisiana, Mississippi, Tennessee	66,399	5.7	16,530	4.2	24.9
Arkansas, Kansas, Nebraska, Oklahoma, Texas	55,996	4.8	3,041	.8	5.4
Iowa, Minnesota, Missouri, Wisconsin	81,683	7.0	16,769	4.3	20.5
Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming	69,171	6.0	1,247	.3	1.8
Undistributed and exports	6,295	.5	137	(1)	2.2
	1,163,192	100.0	391,364	100.0	33.6

[1] Less than 0.1 percent.

CONSUMPTION BY USES

The quantity and value of lime (quick and hydrated) utilized in the principal consuming industries are given in the following table. Chemical lime (including metallurgical) constitutes slightly more than half of the total tonnage sold or used.

Lime sold or used by producers in the United States, 1937–38, by uses

Use	1937				1938			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Agricultural	9.8	406,462	$2,738,433	$6.74	10.9	364,312	$2,376,108	$6.52
Building	23.0	948,553	8,212,995	8.66	25.5	854,461	7,163,165	8.38
Chemical:								
Glassworks	4.1	167,438	1,153,845	6.89	3.8	126,840	859,937	6.78
Metallurgy	16.8	694,814	4,199,960	6.04	14.7	493,522	3,073,625	6.23
Paper mills	10.9	447,728	2,892,552	6.46	12.0	402,021	2,562,317	6.37
Sugar refineries	.5	21,211	179,975	8.48	.7	22,506	185,280	8.23
Tanneries	1.5	61,544	439,849	7.15	1.8	59,853	411,374	6.87
Water purification	5.1	212,213	1,395,728	6.58	5.6	186,211	1,273,491	6.84
Other uses [1]	13.3	546,496	3,659,998	6.70	14.0	470,602	3,136,986	6.67
Total chemical (excluding dead-burned dolomite)	52.2	2,151,444	13,921,907	6.47	52.6	1,761,555	11,503,010	6.53
Refractory lime (dead-burned dolomite)	15.0	617,706	5,217,833	8.45	11.0	366,626	3,095,355	8.44
	100.0	[2] 4,124,165	[2] 30,091,168	7.30	100.0	[2] 3,346,954	[2] 24,137,638	7.21
Hydrated lime (included in above totals)	31.6	1,301,333	10,344,470	7.95	35.0	1,169,804	9,111,575	7.79

[1] Details of distribution shown in a following table.
[2] Includes lime used by producers (captive tonnage) as follows—1937: 270,192 short tons, valued at $1,388,052; 1938: 168,245 tons, $985,003.

Agricultural lime and other liming materials.—In recent years sales of lime for agricultural uses have followed closely fluctuations in cash farm income. Scientific appraisal of the advantages of all types of fertilizers and soil conditioners should encourage a wider use of lime. The accompanying table presents data on several liming agents and their effective lime content.

Agricultural lime and other liming materials sold or used by producers in the United States, 1937–38, by kinds

Kind	1937				1938			
	Short tons		Value		Short tons		Value	
	Gross	Effective lime content [1]	Total	Average	Gross	Effective lime content [1]	Total	Average
Lime from limestone:								
Quicklime	140,425	118,000	$762,496	$5.43	126,539	106,000	$666,550	$5.27
Hydrated	266,037	186,000	1,975,937	7.43	237,773	166,000	1,709,558	7.19
Lime from oyster shells [2]	13,098	10,700	89,119	6.80	(3)	(3)	(3)	(3)
Oyster shells (crushed) [2]	76,966	33,000	273,500	3.55	(3)	(3)	(3)	(3)
Limestone	5,004,930	2,152,000	6,454,695	1.29	4,367,410	1,878,000	5,637,485	1.29
Calcareous marl	46,650	20,000	59,775	1.28	23,572	10,100	40,270	1.71

[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.—Consumption of building lime in 1938 compared favorably with that of other building materials, although sales were lower than in 1937.

Chemical lime.—The wide use of lime in the chemical industries may be inferred from a recently published table [1] that lists the relative frequency with which mineral raw materials are used in the actual manufacture (not purification, treatment, etc.) of 150 important industrial chemicals. In the table, limestone, which in many chemical processes is calcined to the oxide (quicklime) before actual consumption, has a relative use frequency of 63 and was surpassed by only five substances, water, air, coal, sulfur, and salt. The quantity and value of lime sold or used in 1937 and 1938 for minor chemical applications that are designated "Other uses" in a previous table were as follows:

Chemical lime sold or used by producers in the United States for "Other uses," 1937-38

Use	1937		1938	
	Short tons	Value	Short tons	Value
Acid neutralization	3,437	$32,819	5,075	$45,080
Alkali works (ammonia, soda, potash)	13,756	69,809	12,369	68,556
Bleach (liquid and powder)	9,141	57,775	16,844	112,245
Calcium carbide	109,755	565,309	116,173	615,682
Chromate and bichromate	11,216	66,238	13,824	84,538
Coke and gas manufacture (gas purification and plant byproducts)	21,989	143,656	14,844	96,599
Food products	10,664	63,744	6,199	36,860
Gelatin (edible)	4,988	41,743	5,925	43,280
Glue	7,882	57,482	6,456	43,241
Insecticides (spraying materials)	45,967	358,271	43,921	350,054
Magnesia works	10,091	65,908	18,830	135,311
Oil and fat manufacture	20,271	133,116	13,792	93,313
Oil refining	10,161	92,873	6,914	74,772
Paint (calcimine, whitewash, varnish, etc.)	27,240	176,447	12,589	90,866
Polishing and buffing	3,549	78,563	2,307	58,508
Rubber	1,732	13,742	1,330	9,399
Salt refining	5,369	28,774	4,317	24,973
Sand-lime brick	20,746	140,817	14,417	94,350
Sanitation	3,977	25,719	8,693	58,482
Silica brick and slag brick	12,887	96,154	5,733	42,132
Soap	7,362	36,060	6,162	32,611
Wood distillation	6,029	43,126	1,012	7,385
Miscellaneous uses [1]	31,363	208,453	20,044	139,738
Use unspecified	146,924	1,063,400	112,832	779,011
	546,496	3,659,998	470,602	3,136,986

[1] Includes lime used in the manufacture of acetic acid, alcohol, bituminous road materials, beer, calcium acetate, calcium arsenate, calcium carbonate, calcium chloride, calcium phosphate, chemicals (not specified), corn products, dairy products, depilatories, dyes, flour, helium gas, ice, indigo, iron oxide, lubricants, nicotine, oxalic acid, oxygen, retarder, sulfur, sulfuric acid, and textiles.

The consumption of dead-burned dolomite declined greatly in 1938. Sales represented only 11 percent of the total lime business in 1938 contrasted with 15 percent in 1937.

Distribution of lime sales by States and uses in 1938 are shown in the accompanying table.

[1] Keller, R. N., and Quirke, T. T., Mineral Resources of the Chemical Industries: Econ. Geol., vol. 34, No. 3, May 1939, pp. 287-296.

Lime sold or used by producers in the United States in 1938, by States and uses

State	Building		Agricultural		Chemical												Total	
					Glassworks		Paper mills		Water purification		Tanneries		Metallurgy		Other chemical (including dead-burned dolomite)			
	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	46, 595	$308, 504	(1)	(1)	--------	--------	47, 082	$261, 577	(1)	(1)	--------	--------	46, 804	$262, 845	9, 750	$66, 347	151, 937	$911, 033
Arizona	(1)	(1)	--------	--------	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)	(1)	(1)	39, 568	353, 224
Arkansas	(1)	(1)	--------	--------	--------	--------	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)
California	22, 912	254, 967	(1)	(1)	--------	--------	2, 504	22, 594	2, 580	$27, 116	(1)	(1)	18, 947	179, 812	23, 277	218, 605	71, 596	712, 388
Colorado	3, 937	40, 389	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	9, 564	95, 207
Connecticut	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	(1)	(1)
Florida	5, 127	51, 399	(1)	(1)	--------	--------	--------	--------	9, 793	90, 937	--------	--------	--------	--------	(1)	(1)	19, 638	185, 286
Georgia	6, 058	50, 786	988	$3, 364	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	7, 046	54, 150
Hawaii	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	(1)	(1)
Idaho	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)
Illinois	20, 743	165, 617	(1)	(1)	--------	--------	10, 284	56, 538	22, 759	159, 075	(1)	(1)	48, 854	336, 568	23, 112	178, 020	135, 256	965, 836
Indiana	7, 369	44, 842	1, 931	12, 921	(1)	(1)	15, 692	84, 335	17, 539	102, 104	2, 551	$16, 655	(1)	(1)	48, 118	271, 494	102, 054	581, 922
Kentucky	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)	--------	--------	--------	--------	(1)	(1)	(1)	(1)
Maine	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Maryland	(1)	(1)	52, 644	354, 311	--------	--------	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	62, 479	446, 013
Massachusetts	52, 017	463, 404	6, 827	50, 297	--------	--------	4, 643	36, 897	--------	--------	(1)	(1)	(1)	(1)	12, 659	89, 559	91, 453	741, 975
Michigan	3, 319	29, 910	(1)	(1)	--------	--------	25, 844	196, 775	2, 727	21, 398	(1)	(1)	7, 279	41, 784	5, 027	41, 609	45, 848	339, 324
Minnesota	(1)	(1)	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	41, 119	285, 489	(1)	(1)	(1)	(1)	47, 539	253, 452	51, 582	311, 873	(1)	(1)	36, 815	191, 379	118, 411	667, 024	298, 151	1, 724, 140
Montana	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)
Nevada	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	19, 940	145, 076
New Mexico	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)
New York	2, 784	21, 096	6, 995	53, 731	--------	--------	3, 409	30, 863	(1)	(1)	858	7, 001	(1)	(1)	7, 469	56, 451	39, 439	302, 360
North Carolina	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)
Ohio	351, 293	2, 966, 475	32, 092	213, 978	119, 739	$816, 242	25, 500	148, 311	10, 935	64, 963	--------	--------	30, 863	178, 032	266, 167	2, 270, 852	836, 589	6, 658, 853
Oklahoma	(1)	(1)	(1)	(1)	--------	--------	--------	--------	(1)	(1)	--------	--------	--------	--------	--------	--------	(1)	(1)
Oregon	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)
Pennsylvania	61, 068	507, 807	169, 799	1, 124, 287	--------	--------	37, 734	253, 728	13, 828	101, 847	21, 594	152, 969	106, 872	684, 972	121, 171	958, 852	532, 066	3, 784, 462
Puerto Rico	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	2, 953	23, 554	2, 953	23, 554
Rhode Island	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	(1)	(1)
South Dakota	(1)	(1)	(1)	(1)	--------	--------	--------	--------	--------	--------	--------	--------	(1)	(1)	--------	--------	(1)	(1)
Tennessee	38, 245	276, 376	(1)	(1)	--------	--------	66, 804	331, 812	13, 436	78, 875	(1)	(1)	20, 811	80, 622	20, 722	117, 673	162, 661	901, 460
Texas	23, 097	212, 666	(1)	(1)	(1)	(1)	(1)	(1)	10, 860	79, 048	--------	--------	487	3, 237	9, 817	100, 638	49, 352	429, 664
Utah	3, 598	41, 118	--------	--------	--------	--------	--------	--------	163	2, 279	--------	--------	21, 767	137, 689	220	3, 304	25, 748	184, 390
Vermont	13, 168	104, 583	8, 031	41, 946	--------	--------	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	23, 512	170, 625	58, 149	415, 846
Virginia	30, 369	223, 521	30, 233	175, 674	(1)	(1)	7, 380	45, 001	6, 819	50, 561	(1)	(1)	22, 676	121, 736	61, 376	380, 751	161, 687	1, 014, 607

Washington	7, 803	85, 454	(1)	(1)	--------	--------	17, 387	176, 578	(1)	(1)	--------	--------	4, 905	49, 283	(1)	(1)	34, 025	348, 332
West Virginia	20, 636	135, 856	22, 277	118, 405	3, 500	20, 757	12, 110	70, 905	1, 725	11, 400	6, 252	37, 010	27, 297	139, 207	69, 267	470, 019	163, 064	1, 003, 559
Wisconsin	25, 981	226, 077	2, 385	13, 974	(1)	(1)	15, 583	120, 939	(1)	(1)	(1)	(1)	(1)	(1)	10, 046	105, 953	55, 993	483, 111
Undistributed	67, 223	666, 829	30, 110	213, 220	3, 601	22, 938	62, 526	472, 012	21, 465	172, 015	28, 598	197, 739	99, 145	666, 459	26, 660	226, 291	170, 698	1, 331, 866
	854, 461	7, 163, 165	364, 312	2, 376, 108	126, 840	859, 937	402, 021	2, 562, 317	186, 211	1, 273, 491	59, 853	411, 374	493, 522	3, 073, 625	[2] 859, 734	[2] 6, 417, 621	3, 346, 954	24, 137, 638

[1] Included under "Undistributed."
[2] Includes 366,626 tons of dead-burned dolomite valued at $3,095,355.

Hydrated lime.—Consumption of hydrated lime in 1938, as shown in the following table, was below that in 1937 for all major uses except sugar refineries and tanneries, which increased slightly.

Hydrated lime sold or used by producers in the United States, 1937–38, by uses

Use	1937		1938	
	Short tons	Value	Short tons	Value
Agricultural	266,037	$1,975,937	237,773	$1,709,558
Building	670,658	5,674,748	598,981	4,947,957
Chemical:				
Glassworks	2,408	22,768	867	5,949
Metallurgy	36,483	246,936	35,296	249,652
Paper mills	32,995	246,062	21,790	161,371
Sugar refineries	12,240	109,006	14,379	121,515
Tanneries	23,045	172,527	26,075	182,762
Water purification	111,167	792,408	94,972	694,103
Other uses	146,300	1,104,078	139,671	1,038,708
Total chemical	364,638	2,693,785	333,050	2,454,060
	1,301,333	10,344,470	1,169,804	9,111,575

SIZE OF PLANTS

The following table presents data on the number of companies and plants grouped according to the quantity of lime produced in selected years. Total production of the various groups is also shown. Noteworthy features are the increase in the number of active plants producing between 25,000 and 49,999 short tons from 26 in 1928 to 35 in 1938, also the increase in the proportion of the total output made by plants producing 10,000 to 49,999 tons annually.

Lime (including dead-burned dolomite) sold or used by producers in the United States, 1928, 1933, and 1938, by companies and plants grouped according to size

Size group (short tons per year)	1928			1933			1938		
	Companies	Plants	Short tons	Companies	Plants	Short tons	Companies	Plants	Short tons
Less than 1,000	152	152	37,556	143	143	39,374	98	98	27,931
1,000 to 4,999	74	74	186,218	70	70	169,760	77	79	179,875
5,000 to 9,999	44	46	320,443	31	32	217,706	30	32	213,831
10,000 to 24,999	47	51	741,887	30	39	512,397	40	42	633,847
25,000 to 49,999	19	26	681,538	17	25	560,600	27	35	963,041
50,000 to 99,999	17	34	1,141,000	7	15	548,721	6	12	456,525
100,000 and over	10	28	1,349,770	2	8	220,722	6	23	871,904
	363	411	4,458,412	300	332	2,269,280	284	321	3,346,954

TRENDS IN PRINCIPAL USES

Sales of chemical lime (including metallurgical) and dead-burned dolomite comprised 64 percent of the total sales of lime in 1938 compared with 67 percent in 1937. This decline, which was caused chiefly by the large decrease in sales of dead-burned dolomite, modifies the trend lines materially, as shown in figure 1. Conditions in 1938 indicated the formation of trends similar to those of the early 1920's when sales of building lime formed approximately half of the total lime sales compared with about one-fourth of the total in recent years. However, as the drastic decrease in sales of metallurgical lime and dead-burned dolomite in 1938 resulted from the low rate of operation in the steel industry, the pronounced change in the relative magnitude

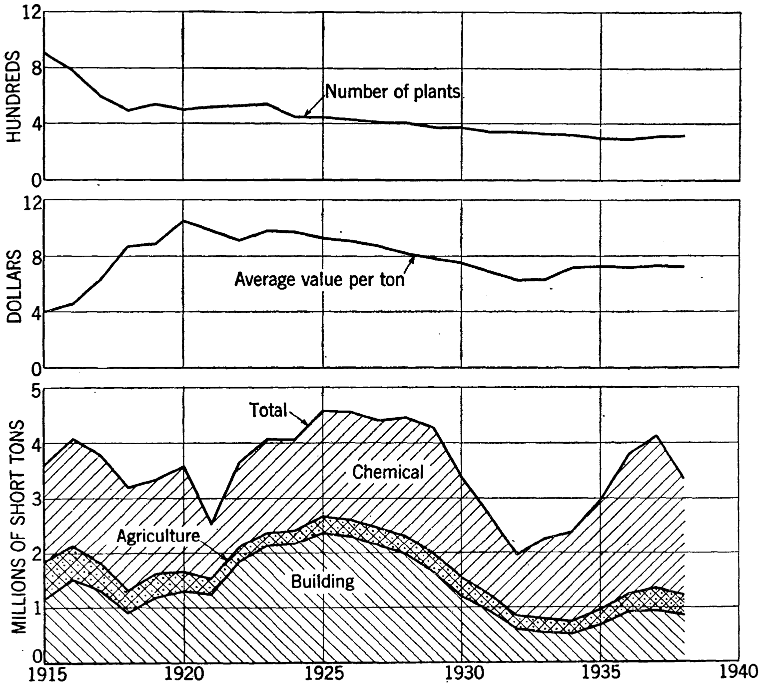

FIGURE 1.—Trends in the number of active plants, average value per ton, and principal uses of lime, 1915–38.

of sales of chemical and building lime in 1938 compared with recent preceding years is believed to be temporary only and not significant in the long-time trend.

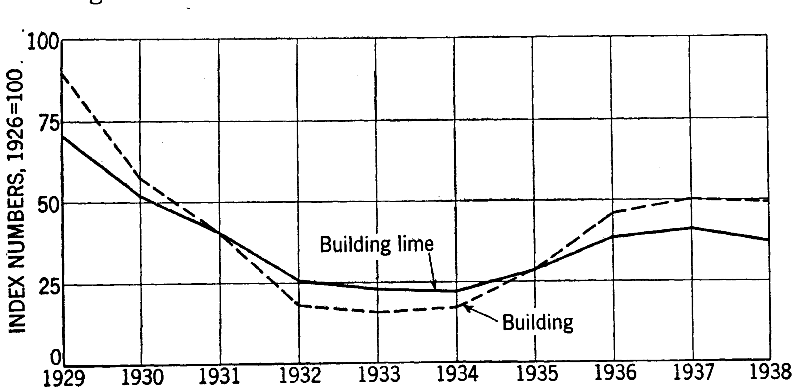

FIGURE 2.—Building-lime (quick and hydrated) sales compared with total floor area of residential and nonresidential building, 1929–38. Index numbers on building computed from F. W. Dodge Corporation data.

Figure 2 shows graphically the total quantity of lime consumed in building construction compared with the floor area of residential and nonresidential building during the 10-year period, 1929–38.

Metallurgical lime is used chiefly for open-hearth flux in the steel industry, but minor quantities are consumed in the flotation of metallic ores, cyanidation of gold ores, smelting, and wire drawing. The relatively large use of metallurgical lime compared with steel-ingot production since 1933, as shown in figure 3, was due to an increase in the quantity of lime used in flotation and cyanidation. The disproportional rise in sales of dead-burned dolomite since 1932 compared with steel-ingot production resulted from the increasing substitution of this low-priced refractory material for higher-priced refractories in the steel industry.

NEW DEVELOPMENTS

Specifications.—A tentative specification (C141–38T) for hydraulic hydrated lime for structural uses has been issued by the American Society for Testing Materials. Two types, high-calcium (containing

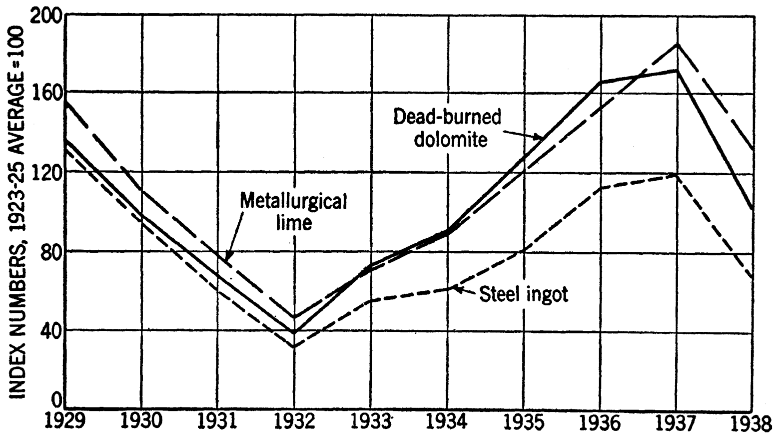

FIGURE 3.—Metallurgical lime and dead-burned dolomite sales compared with steel-ingot production, 1929–38. Index numbers on steel ingots computed by Federal Reserve Board from data of American Iron and Steel Institute.

not more than 5 percent MgO) and magnesium (containing more than 5 percent MgO) hydraulic hydrated limes, are covered.

The Federal Specifications Executive Committee has also issued a specification (SS–L–361) that covers the requirements for hydraulic hydrated lime purchased by Federal agencies.[2]

The National Lime Association after lengthy investigations has issued specifications covering lime and lime-cement mortars for use in unit masonry. These mortars contain more lime than the present-day masonry mortars and are said to afford a better bond with the building units and more weather-resistant construction.

Plants.—Only a few entirely new lime plants, all of relatively small capacity, were constructed during the year. Existing equipment was improved or replaced at numerous plants in all sections of the country. Capacity was increased at several plants by the addition of new kilns. Several companies substituted pulverized coal for producer gas as fuel for rotary kilns. The replacement is said to yield

[2] Copies of Federal specifications may be obtained upon application accompanied by money order, coupon, or cash, to the Superintendent of Documents, Government Printing Office, Washington, D. C. American Society for Testing Materials specifications may be obtained from the office of the secretary of the society, 260 South Broad Street, Philadelphia, Pa.

better heat control with more efficient calcination and a reduction in costs. The reported [3] successful use of pulverized coal as fuel for shaft kilns is of interest to operators. This fuel replaced natural gas and has been used for the past several years in three kilns, of which two operated on lump limestone and one on spalls down to 1-inch size. Although the performance of the kilns varies, the average results show increased capacity and efficiency.

The successful operation [4] of a plant to manufacture carbon dioxide gas, liquid and solid (dry ice), from kiln gases of an existing lime plant was an outstanding development of the year. Capacity is reported as 15 tons of dry ice per day, which is obtained by processing the gases from one of three shaft kilns, each of which has a daily capacity of 15 tons of lime.

In 1938 a record enrollment of 35 lime plants participated in the safety contest [5] sponsored by the National Lime Association and the Bureau of Mines. The combined accident-frequency and accident-severity rates of the enrolled plants increased over 1937 and were respectively 25.2 per million man-hours of exposure and 4.3 days of disability per thousand man-hours in 1938.

Research.—Results of investigations by Conley [6] on the rate of calcination of cylinders of limestone, dolomite, and magnesite show that calcination proceeds at a fairly uniform rate, which is directly proportional to the exposed surface and the temperature.

FOREIGN TRADE [7]

Imports.—Imports of lime, most of which is brought into Washington and California, were lower in 1938 than in 1937. The quantity and value of imports of dead-burned dolomite decreased considerably from 1937. The following tables present data on lime and dead-burned dolomite imported for consumption.

Lime imported for consumption in the United States, 1934–38

Year	Hydrated lime [1]		Other lime [1]		Dead-burned dolomite [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	923	$8,872	8,309	$74,447	6,473	$166,912	15,705	$250,231
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

[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."

[3] Nordberg, Bror, Firing Shaft Lime Kilns with Unit Coal Mills: Rock Products, vol. 42, No. 3, March 1939, pp. 41–42.
[4] Rock Products, Dry Ice from Lime Kiln Gases: Vol. 41, No. 7, July 1938, pp. 31–33.
[5] Bureau of Mines, The National Lime Association Safety Contest of 1938, Health and Safety Statistics Series 261.
[6] Conley, J. E., Calcination Conditions for Limestone, Dolomite, and Magnesite: Am. Inst. Min. and Met. Eng. Tech. Paper 1037, 1939, 15 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.

Lime imported for consumption in the United States, 1937–38, by countries and customs districts [1]

Country	Customs district	1937 Short tons	1937 Value	1938 Short tons	1938 Value
Belgium	San Antonio			6	$53
Canada	Chicago			1	13
	Los Angeles	647	$6,447		
	Maine and New Hampshire	143	1,125	51	280
	New York	17	218		
	St. Lawrence	1	18		
	San Francisco	3,458	34,238	2,052	19,392
	Vermont	5	58		
	Washington	4,405	45,035	4,618	43,914
Germany	New York	14	2,013	16	1,543
	Pittsburgh	(2)	132	(2)	65
Japan	Washington			(2)	10
Mexico	San Antonio	40	205	44	108
Sweden	New York			7	173
Switzerland	do	(2)	48	(2)	23
United Kingdom	do	57	1,057	23	629
West Indies, British	Virgin Islands	1	11		
		[3] 8,788	90,605	[3] 6,818	66,203

[1] Exclusive of dead-burned basic refractory material.
[2] Less than 1 ton.
[3] Includes weight of immediate container.

Exports.—Exports of lime in 1938 increased in quantity but decreased in total value compared with 1937. The average value per ton (c. i. f. shipping port) was only $9.20 in 1938 against $10.88 in 1937. Details are shown in the following tables:

Lime exported from the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	3,752	$60,167	1937	11,300	$122,895
1935	3,927	63,672	1938	13,222	121,662
1936	4,601	71,109			

Lime exported from the United States, 1937–38, by countries

Country	1937 Short tons	1937 Value	1938 Short tons	1938 Value
Argentina	94	$2,452	41	$1,481
Canada	5,760	41,715	6,940	37,255
Colombia	2	54	250	5,615
Cuba	196	1,936	389	4,612
Ecuador	53	2,701	63	1,641
France	22	724	27	881
Guatemala	315	2,943	800	6,516
Haiti			67	832
Honduras	1,754	14,242	2	45
Japan	476	12,931	171	4,599
Mexico	443	4,787	2,457	21,516
Newfoundland and Labrador	58	586		
New Zealand	53	694	65	846
Nicaragua	421	9,250	417	5,124
Panama	122	2,463	155	2,728
Peru	654	8,621	602	10,077
Philippine Islands	1	27	51	1,993
Salvador	63	761	45	607
Sweden	72	2,672	82	3,550
Union of South Africa	25	254	58	700
U. S. S. R.	30	1,150		
United Kingdom	45	502	101	3,510
West Indies:				
British	476	8,630	310	5,617
Netherland	78	1,191	93	1,131
Other countries [1]	87	1,609	36	786
	11,300	122,895	13,222	121,662

[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 R. W. Metcalf [1]

SUMMARY OUTLINE

In 1938, notwithstanding further displacement of foreign by domestic clays, the quantity of china clay sold or used by producers in the United States dropped 19 percent, ball clay 22 percent, and fire clay 48 percent from the 1937 levels, representing the results of recession in the consuming industries. A decline of 24 percent in the output of bleaching clay (fuller's earth), however, is attributed largely to the increasing use of substitutes. Bentonite sales were about the same as during the preceding year, reduced requirement in some consuming lines being offset by increased use in others. The heavy-clay-products industries—raw material for which is used chiefly at the locality where it is obtained and hence is not included in Bureau of Mines production figures—fell off slightly. Although building-contract awards in 1938 were substantially greater than those reported for 1937, the improvement was confined to the last few months, and deliveries of many kinds of building materials, including brick and tile, did not share the upturn until after the close of the year.

Under the Anglo-American Trade Agreement, the duty on kaolin or china clay was reduced, effective January 1, 1939, from $2.50 to $1.75 per long ton, the duty on fuller's earth was cut from $1.50 to $1 per ton, and that on "wrought or manufactured" fuller's earth was dropped from $3.25 to $2 per ton. Other reductions under this agreement included the duties on brick (reduced from 25 percent to 15 percent) and on floor, wall, and quarry tiles (various rates). The second trade agreement between the United States and Canada, also effective January 1, 1939, resulted in reductions on fire brick (now 12½ percent) on common brick and other kinds of undecorated brick (now $1 per 1,000); it also halved the duties on bentonite.

[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 clay industry of the United States, 1930–34 (average) and 1935–38

	1930-34 (average)	1935	1936	1937	1938
Domestic clay sold by producers:					
Kaolin, china clay.........short tons..	431,932	523,656	638,939	732,282	595,054
Ball clay.........................do....	70,299	96,260	101,324	121,470	94,968
Fire clay (including stoneware clay) short tons..	1,487,364	1,938,391	2,471,575	2,785,344	1,458,941
Bentonite.........................do....	84,762	157,445	177,807	194,768	192,183
Fuller's earth....................do....	259,354	227,745	230,814	226,165	170,852
Miscellaneous clays...............do....	305,973	207,718	392,783	403,522	389,715
Total domestic:					
Quantity..........................do....	2,639,684	3,151,215	4,013,242	4,463,551	2,901,713
Value..................................	$10,977,776	$13,054,152	$15,688,434	$18,004,158	$13,483,441
Imports:					
Kaolin or china clay.......short tons..	140,888	125,963	139,797	146,523	84,180
Common blue and Gross-Almerode short tons..	11,306	15,552	32,166	38,549	20,404
Fuller's earth....................do....	4,708	2,935	2,733	2,286	1,507
Other clay........................do....	24,713	31,941	21,183	17,946	6,968
Total imports:					
Quantity..........................do....	181,615	176,391	195,879	205,304	113,059
Value..................................	$1,595,101	$1,672,814	$1,896,642	$1,950,043	$1,127,462
Exports:					
Fire clay..................short tons..	39,709	49,949	65,874	77,330	55,764
Other clay [1]....................do....	68,978	101,524	90,569	91,480	76,383
Total exports:					
Quantity..........................do....	108,687	151,473	156,443	168,810	132,147
Value..................................	$1,323,744	$1,865,069	$1,844,038	$1,948,425	$1,565,567

[1] Includes fuller's earth.

CHINA CLAY OR KAOLIN

Sales of domestic kaolin or china clay dropped in 1938 to 595,054 short tons valued at $4,740,880—substantially below the 1937 record of 732,282 tons worth $5,349,636, but almost equaling the 1936 total and well above that of any other preceding year. Imports, on the other hand, were far less in 1938 than in any previous year since 1897, amounting to only 84,180 short tons valued at $753,858 (43 percent less in quantity than in 1937). The change in the duty on china clay, effective January 1, 1939, was not announced early enough in the year to encourage postponing purchases to take advantage of the reduction, but consumers of English clays had overbought in 1937. The potters especially had to curtail operations more than did many of the consumers of American clays, which have not yet succeeded in obtaining wide adoption in plants making hotel china and certain kinds of sanitary ware and electrical porcelain.

The heaviest declines in domestic production in 1938 were in Georgia and South Carolina, which supply most of the paper and rubber clays. Output in California virtually matched the 1937 record; and even in Pennsylvania, which has a more diversified market, the decrease was moderate.

The average price of domestic sales in 1938 was $7.97 a short ton, or substantially higher than the average of $7.31 for the preceding year. Some producers accepted lower prices for their paper filler clays, and possibly for their rubber clays, but these reductions were more than offset by the higher averages reported by several producers who have notably improved the quality of their products. The main reason for the increase in the average, however, was the relatively great reduction in shipments of low-priced refractory kaolins from Georgia compared with those of the more expensive kinds.

Quotations throughout 1938 generally remained about where they were at the end of 1937. Paper filler clays, produced principally in Georgia, ranged in price mostly from $6 to $8 a ton, f. o. b. mines, whereas coating clays ran from this range upward to $20 or more a ton. The average prices, as reported by producers, were approximately $8 and $12 for filler and coating clays, respectively, in 1938 compared with $7.08 and $10.74 in 1937. Rubber clays in 1938 ranged from $7.50 to $11 a ton, and the average price rose above $9.75, f. o. b. Georgia or South Carolina shipping points, compared with $8.80 in 1937—again denoting an increased proportion of highly processed clays. Notwithstanding the fact that North Carolina potting clays are so much better prepared now than ever before, they are still quotable around $15 a ton f. o. b. mines.

Price schedules for English clays were virtually unchanged in 1938. However, charter rates for cargo shipments from Cornish ports, after rising to 19s. or more in 1937, ranged throughout most of 1938 at 15s. to 15s. 6d. a long ton and ocean rates on German clays fell from $4.75 to $4.50 and later to $3.75 a metric ton.

Kaolin sold by producers in the United States, 1936–38, by States

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	(1)	(1)	-----	-----	-----	-----
California	5,772	$53,053	6,674	$62,959	7,057	$50,771
Delaware	(1)	(1)	(1)	(1)	(1)	(1)
Florida	(1)	(1)	(1)	(1)	(1)	(1)
Georgia	419,395	2,895,878	503,732	3,546,059	412,632	3,314,918
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	-----	-----
North Carolina	8,657	126,353	(1)	(1)	(1)	(1)
Pennsylvania	42,370	138,962	45,916	152,996	44,312	146,289
South Carolina	128,199	965,183	129,120	1,053,805	98,924	865,177
Utah	-----	-----	(1)	(1)	(1)	(1)
Virginia	(1)	(1)	(1)	(1)	(1)	(1)
Washington	-----	-----	-----	-----	(1)	(1)
Undistributed [2]	34,546	358,309	46,840	533,817	32,129	363,725
	638,939	4,537,738	732,282	5,349,636	595,054	4,740,880

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

Georgia kaolin sold by producers, 1934–38, 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
1934	236,606	$1,535,046	$6.49	47,950	$86,177	$1.80	284,556	$1,621,223	$5.70
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

BALL CLAY

Shipments of ball clay from domestic mines totaled 94,968 short tons valued at $739,691 in 1938 compared with 121,470 tons and $890,705 during the preceding year. The 1937 figures, however, were an all-time record, and the 1938 shipments were well above the averages for earlier years when general business was much more active. Separate statistics showing imports of ball clays are not available, but tonnage receipts under the general classification of "common blue and ball clay," which ordinarily consists principally of English ball clays, were 46 percent less than in 1937. American ball clays, which are produced almost wholly in Kentucky and Tennessee, are about $4 a ton cheaper than English clays of similar quality and are being accepted by American potters and other consumers, many of whom have come around to the opinion that they are as good or better than the foreign clays that at one time were universally preferred.

Eighty percent of the shipments of domestic ball clay in 1938 were used in the manufacture of white pottery or cream-color ware, 17 percent in high-grade tile, and the remaining 3 percent in a variety of products, including architectural terra cotta, linoleum, paints, refractory brick, enamels, and miscellaneous articles.

Ball clay sold by producers in the United States, 1936–38

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
California					(1)	(1)
Illinois	(1)	(1)	(1)	(1)	(1)	(1)
Kentucky	56,006	$388,235	58,118	$441,316	45,494	$362,094
Maryland	(1)	(1)	(1)	(1)	(1)	(1)
Missouri	(1)	(1)	(1)	(1)	(1)	(1)
New Jersey	10,135	51,277	9,061	52,142	3,496	23,202
Tennessee	27,504	209,357	49,196	362,179	40,207	295,587
Undistributed [2]	7,679	47,046	5,095	35,068	5,771	58,808
	101,324	695,915	121,470	890,705	94,968	739,691

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)."

FIRE CLAY

Owing to inactivity in the refractories industries and listless demand from metallurgical plants, shipments of fire clay from domestic mines were less in 1938 than in any previous year since 1934. The total shipments of fire clay and stoneware clay were 1,458,941 short tons valued at $4,060,160 in 1938 compared with 2,785,344 tons worth $7,180,938 in 1937, 48 percent less in quantity and 43 percent less in value.

Gross-Almerode glass-pot clay is a German clay that formerly was used extensively in this country in the manufacture of pots and tanks in which glass was melted; clays of this type burn dense at a relatively low temperature and are relatively free from impurities that would color glass. In 1938 the imports of these glass-pot clays aggregated only 205 short tons valued at $2,470 compared with 1,737 tons and $21,645 in 1937 and 2,145 tons and $26,852 in 1936, the first year for which separate statistics are available. In earlier years, however, they were much larger.

A well-known British observer has reported [2] that glass-pot makers in the United States are divided in opinion as to whether the best pots are made from 100 percent American clay or from mixtures of European and American clays. The pots themselves have been displaced to a large degree by tank furnaces, and for tank-furnace linings sillimanite and electrically cast products have tended to displace fire-clay blocks.

Imports of miscellaneous clays, including Klingenberg and certain other German fire clays as well as smaller amounts of clay of various kinds from other countries, decreased to 5,683 tons valued at $83,384 in 1938 compared with 15,558 tons valued at $203,383 in 1937 and 18,034 tons valued at $281,592 in 1936. In this group are included such specialized importations as pipe clays, pencil clays, emery wheel clays, enamel clays (other than kaolin and ball clay), etc. The total imports of fire clay, although not reported separately, probably have averaged in recent years only about one-third as much as the exports.

Exports of fire clay in 1938 were 55,764 tons worth $389,042 as against 77,330 tons worth $529,661 during the preceding year. Canada always has been the principal foreign market for American fire clay, taking about 80 percent of the total exports.

Workable deposits of fire clay are distributed widely throughout the United States, but over 75 percent of all domestic sales have been produced in Pennsylvania, Missouri, Ohio, California, Kentucky, Illinois, and New Jersey. Plastic fire clay and a smaller amount of the hard type, known as flint clay, occur in the coal measures of the Middle West and are particularly abundant in Pennsylvania, Ohio, Maryland, and Kentucky. Plastic clays, laid down before the Carboniferous and unassociated with coal, are mined in New Jersey. Refractory clays of Tertiary and other later geologic ages are worked in Texas, Mississippi, California, Washington, and Colorado. Diaspore and so-called burley clays (high-alumina) are mined only in the north central Ozark region of Missouri.

Anticipating refractory clay requirements of metallurgical industries that may be attracted by cheap electrical power from Bonneville Dam, the Oregon State Department of Geology and Mineral Industries in cooperation with the University of Washington and the Bureau of Mines, United States Department of the Interior, conducted an investigation indicating that, contrary to former opinion, western Oregon has large deposits of good fire clay and can supply the future requirements of electrometallurgical and other industries in the Pacific Northwest.[3]

For several years the Bureau of Mines has deemed it advisable to include stoneware clays in the same classification with fire clay. Stoneware clays, which are characteristically somewhat less refractory than fire clay and have a long vitrification range, are produced principally in Ohio and Illinois and are used not only for stoneware but also for yellow ware, artware, sanitary ware, and architectural terra cotta. They have the properties of a kaolin and a ball clay

[2] Turner, W. E. S., The American Glass Industry: Chem. Age (London) vol. 40, No. 1027, March 1938, p. 160.

[3] Wilson, Hewitt, and Treasher, R. C., Refractory Clays of Western Oregon: Oregon Dept. of Geol. and Mineral Industries. Bull. 6, 1938, 93 pp. (typescript).

combined but usually contain an excess of silica and a little iron. A portion of the iron appears as specks in the fired ware; this is not objectionable for ordinary stoneware but makes the clay unsuitable for whiteware. Proper beneficiation, however, may make it possible to eliminate the iron so that the material may be used for dinnerware.

The average price of domestic fire clay and stoneware clay f. o. b. mines in 1938 was $2.78 a ton, compared with an average of only $2.48 a ton as recently as 1936. These averages show a definite rising trend. About 1900 this composite value was generally around $1 a ton, by 1914 it had risen to $1.50, and after exceeding $3 during the post-war boom (but later declining to $2.50 a ton) it seems once more to be rising to $3. Part of this increase may be attributed to more preparation, yielding a better product, but it is likely that mining costs have advanced, increased mechanization being offset by exhaustion of the more easily worked deposits.

The principal use of fire clay is for making fire-clay brick, and large quantities of ground fire clay also are used in fire-clay mortars for laying firebrick and for various refractory purposes in foundries and steel works. The leading outlets outside refractories are pottery and stoneware, saggers and wads for firing pottery, and architectural terra cotta. The production of fire-clay brick in the United States had begun to decline slightly even before 1929, when the output was 938 million brick, valued at $36,169,000. This compares with a top value of $53,416,000 in 1920 and a volume peak of 1,304 million with a value of $42,502,000 in 1917. In 1932 volume dropped to 217 million, worth $7,611,000. Following a recovery to 711 million, valued at $33,730,843 in 1937, the output undoubtedly declined sharply in 1938. Sales of refractory products normally are the first to feel the effects of a business recession and among the last to pick up again during recovery.

Fire clay, including stoneware clay, sold by producers in the United States, 1936–38, by States

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Alabama	66,352	$85,827	66,714	$94,054	22,871	$38,885
California	167,295	326,366	206,674	433,405	146,296	338,072
Colorado	54,433	78,567	59,828	93,587	48,702	65,678
Illinois	124,806	271,006	156,674	306,891	89,743	203,582
Indiana	36,572	63,166	31,345	58,612	13,852	30,172
Kentucky	181,345	470,020	282,003	750,505	102,836	304,466
Maryland	21,429	72,314	23,634	55,047	13,189	40,977
Missouri [1]	471,546	1,331,432	519,369	1,525,519	258,656	904,522
New Jersey	87,294	473,060	88,890	462,529	69,944	358,876
New Mexico	(2)	(2)	3,959	8,523	3,927	6,923
Ohio	406,896	860,236	446,999	988,963	254,719	566,439
Pennsylvania	733,049	1,741,633	779,745	2,038,524	338,864	927,370
Tennessee	19,069	71,846	18,303	73,166	12,149	51,448
Texas	6,394	57,071	7,576	82,583	5,113	33,414
Utah	(2)	(2)	9,269	19,256	12,520	26,103
Washington	17,137	51,570	28,787	46,161	27,082	51,469
West Virginia	55,767	99,709	48,619	94,413	31,658	68,687
Other States [3]	22,191	81,741	6,956	49,200	6,820	43,077
	2,471,575	6,135,564	2,785,344	7,180,938	1,458,941	4,060,160

[1] Includes diaspore and burley clay as follows—1936: 33,584 tons valued at $150,455; 1937: 49,769 tons, $245,395; 1938: 33,408 tons, $151,623.
[2] Included under "Other States."
[3] Includes States indicated by "(2)" and Arkansas, Connecticut, Idaho, Iowa, Massachusetts, Minnesota, Montana, Nebraska, New York, North Carolina, North Dakota, Oregon, South Carolina, and Virginia.

BENTONITE

Development of even more new uses for bentonite nearly balanced a drop in consumption in certain other industries, with the result that the output in 1938 was 192,183 short tons valued at $1,373,182, compared with 194,768 tons worth $1,500,758 in 1937. No longer than a dozen years ago, the output of this extraordinary material was almost negligible.

Small quantities of bentonite have been imported from Canada for a decade or more, but since 1930 (when separate statistics first became available) the only imports of "unwrought" bentonite have been $49 worth imported from Germany in 1932 and 1 ton valued at $5 from Italy in 1938. Imports of "wrought" bentonite likewise have been insignificant since 1930, comprising only $70 worth in 1936 (chiefly German), 1 ton valued at $30 from Canada in 1937, and 6 tons valued at $223 from Italy in 1938. The 1938 receipts from Italy are of special interest, inasmuch as they came from the newly discovered deposits of white bentonite that is not as abundant in this country as the other types. Under the trade agreement with Canada, the duty on crude bentonite was reduced from $1.50 to $0.75 a long ton and that on "wrought or manufactured" material from $3.25 to $1.625.

Exports of bentonite are included in the statistical classification "all other clays." Type 1 ("Wyoming" type) bentonite is shipped from the United States all over the world, and an examination of the high unit values for exports under this classification from the Los Angeles customs district suggests that activated earths, made by processing Type 2 (nonswelling) bentonite, likewise may be included in this same classification.

Possibly the most interesting development in the industry during 1938 was the reported discovery by Dr. Ernst A. Hauser, Massachusetts Institute of Technology chemistry professor, that bentonite films may be processed to afford a successful substitute for mica in various important uses. This new product, which is expected to come on the market in at least a small way during 1939, has been called Alsifilm, emphasizing its hydrous-aluminum-silicate composition. According to Dr. Hauser, possibly the first important commercial outlet may be as insulating tapes for wrapping wires and telephone cables. These films, however, are said to be fireproof, waterproof, chemically inert, unaffected by mold, unattractive to insects, transparent, flexible, and fairly tough. Consequently, their employment for a variety of uses where dielectric properties are not needed is suggested. It is claimed that they take ink readily and thus may prove useful for permanent documents; moreover, that they can be made of any desired thickness like built-up mica or sheets of paper glued together, only without needing any additional binder. Other uses proposed are to line food or beverage containers and to wrap butter, tobacco, cigarettes, and other perishable or oily products. Ordinarily flexible, or even creaseproof, the material may be modified in appearance and properties by incorporating various pigments and fillers.

In talking with a member of the Bureau of Mines staff, Doctor Hauser explained the formation of these films as due to the attachment of colloidal clay particles end to end in strings or tiny filaments that mat like organic fibers do in the manufacture of ordinary paper or felt. Although produced experimentally at first in an ultra-centrifuge, the films were later manufactured by various methods. At the moment extrusion of the moist jelly seems the most practical method of commercial production because it can be embodied readily in a continuous process whereby Doctor Hauser believes the material probably can be manufactured at a cost of only a few cents a pound. The hardening of the films to make them impervious to liquids is a separate treatment about which very little has been published. In addition to various types of bentonite, other sources of hydrous aluminum silicates have been utilized experimentally. The product from ordinary Wyoming bentonite is not colorless; in fact, it looks like oiled paper. By using a white bentonite, low in iron, however, the product can be made almost perfectly transparent.

Under the cooperative agreement between the Massachusetts Institute of Technology and the Research Corporation (137 Newbury Street, Boston, Mass.), the latter undertakes the patent protection and commercial development under a policy of making the discovery as widely available as possible. Profits from all the various enterprises conducted by the Research Corporation are reinvested in research.

Consumption of bentonite in foreign countries has not paced that in the United States, owing to its high price abroad. Domestic bentonite has been exported all over the world, but only in rather small quantities. Large, scattered bodies of bentonite have been reported in Germany, but German bentonite differs greatly in many physical properties from the American bentonites, because it contains calcium as the exchangeable base instead of sodium; some German clays, however, are being treated artificially to exchange the calcium for sodium.

European interest has been stimulated recently by the discovery of several new deposits. The U. S. S. R. is said to have large deposits of bentonite, and Italy has opened up what was reported to be an important group of deposits on the Island of Ponza, one of the Pontine group off the west coast between Rome and Naples. Samples of this new Italian material are of excellent quality and are of the swelling type, though differing from Wyoming bentonite in that they are virtually pure white. Trial shipments have been made to the United States, and already the Italians have used it in steel molding sands. Several important deposits have been found in the Western Provinces of Canada, and in 1938 the Canadian output jumped to 1,136 tons from 163 tons in 1937. Occurrences have been reported also in Japan, British India, France, Mexico, China, and New Zealand.

Bentonite prices have remained nominally $8 a ton in bulk and $10 in bags for the crude clay (dried and crushed), f. o. b. Wyoming mines, whereas selected air-floated material is quoted at $25 a ton at Chicago. As reported to the Bureau of Mines, crude bentonite ranges in price from $4 to $8 a ton, according to quality and locality. The milled clay generally sells in South Dakota at $7.50 to $8 a ton, f. o. b. cars, and in other parts of the country material prepared for oil-well drilling varies in price upward to $20.

Bentonite sold by producers in the United States, 1935–38, by States

State	1935		1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Arkansas	(1)	(1)						
California	29,496	$176,571	12,294	$144,863	15,561	$204,672	15,703	$166,998
Mississippi			(1)	(1)	(1)	(1)	(1)	(1)
New Mexico					(1)	(1)	(1)	(1)
Oklahoma	4,805	58,508	(1)	(1)	(1)	(1)	(1)	(1)
South Dakota	8,923	40,001	(1)	(1)	(1)	(1)	20,565	155,821
Texas	39,391	237,123	22,647	154,216	19,910	144,661	21,744	207,084
Utah	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Wyoming	34,415	350,846	55,090	520,852	67,958	659,111	58,911	530,834
Undistributed [2]	40,415	184,551	87,776	547,489	91,339	492,314	75,260	312,445
	157,445	1,047,600	177,807	1,367,420	194,768	1,500,758	192,183	1,373,182

[1] Included under "Undistributed."
[2] Includes States indicated by "(1)".

FULLER'S EARTH

Confirming the recent trend toward use of smaller quantities but better qualities of bleaching clays, Bureau of Mines figures for fuller's earth consumption in the United States show a 24-percent drop in 1938, when domestic production of fuller's earth or natural bleaching clays fell to 170,852 short tons valued at $1,707,869 compared with 226,165 tons worth $2,296,094 in 1937 and 230,814 tons worth $2,264,978 in 1936. Imports—which have been unimportant in recent years, averaging less than 2 percent of annual consumption during the last decade—also decreased further in 1938, while exports increased, though not importantly.

The predominant use of fuller's earth is in oil refining, and shipments of fuller's earth from domestic mines paralleled expansion of the petroleum industry for several decades, increasing steadily from an annual average of 40,000 tons before the World War to a peak of 335,644 tons in 1930. Following a temporary setback in the early years of the general business depression, petroleum refining resumed its strong uptrend, whereas the use of fuller's earth failed to increase after 1932. The failure of fuller's earth consumption to equal the greater activity in petroleum refining is due in part to a relative reduction in the output of lubricants, the branch of the refining industry that uses the largest proportion of bleaching clay. But new methods of processing that require much smaller additions of fuller's earth, and the substitution of other bleaching materials—first, activated earths and, in 1938, bauxite—are even more depressing factors.

Figure 1 compares fuller's earth consumption with the index of petroleum refining and with the production of lubricants. The declining proportion of lubricating oils in relation to gasoline consumption in automobiles is attributed to an increase in the average interval between oil changes. Formerly it was common practice to change oil every 500 miles; but now some car manufacturers recommend changes only every 2,000 or 5,000 miles, and some truck operators never change their oil.

In recent years about 10 percent of the domestic output of fuller's earth has been used in the refining of vegetable oils and animal fats, a general increase in the tonnage being attributable to the growth of these industries and to gradual displacement of imported by domestic earths. Formerly English earth was considered indispensable; it filtered well, with minimum retention of oil, and, more important, all available domestic clays imparted an unpleasant taste to the oil. With the opening up of new deposits, the use of domestic clays for treating edible products increased until 1938, when shipments to vegetable and animal oil refineries also decreased sharply, probably because of competition from artificially activated or acid-treated earths.

The United States is by far the largest producer of fuller's earth and normally exports as much as 5 percent of its domestic production. Whereas imports consist of relatively costly earths for use principally in refining edible oils and fats, exports comprise less expensive earths for use in mineral-oil refining. Exports of fuller's earth are not re-

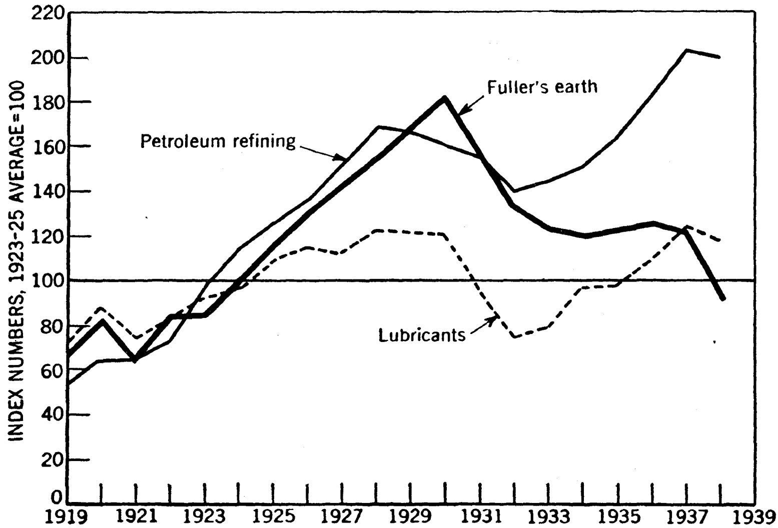

FIGURE 1.—Consumption of fuller's earth compared with petroleum refining activity (Federal Reserve Board index) and production of lubricants, 1919–38.

ported separately in the official statistics of the United States, but since 1923 domestic producers have reported their foreign shipments to the Bureau of Mines. In 1938 such shipments aggregated 10,046 short tons valued at $81,175 ($8.08 per ton) compared with 8,104 tons, worth $70,985 ($8.76 per ton) in 1937, 6,118 tons, worth $56,180 ($9.18 per ton) in 1936 and a maximum quantity of 21,264 tons in 1929, when the average value was $12.15 a ton. In 1927, when 12,287 tons were exported, the average value was $15.61.

Canada has been the most important single export market for fuller's earth in recent years, but shipments have been made to oil refineries all over the world. However, most countries having sizeable petroleum industries are able to obtain suitable bleaching earths locally, and international trade in fuller's earth is confined largely to the exports of American earth to mineral-oil refineries and of English earth to refineries treating edible oils and animal fats. Germany, which has large deposits of fuller's earth in Bavaria, produces a clay that is much less efficient than English or American earths in its natural state but is converted by hydrochloric acid treatment into an activated product that has a bleaching power two or three times as great. Somewhat similar activated material is made in California and Mississippi from bentonites having virtually no decolorizing power in the raw state. It is commonly claimed that the greatly improved domestic material now equals the German product in efficiency. Imports of the latter have diminished greatly, and the American activated earth is exported in substantial quantities.

Recently the United States Court of Customs and Patent Appeals upheld a decision that the German product (trade name "Tonsil") was dutiable at ¼ cent a pound and 30 percent ad valorem as "clays or earths artificially activated with acid or other material" rather than at $3.25 a ton as "fuller's earth, wrought or manufactured." The court avoided a decision on whether the product was a bentonitic clay and based its finding upon the evidence that the activity of the earth actually was increased by the acid treatment.[4]

The average value of the fuller's earth produced in the United States in 1938 was $10 a ton, f. o. b. mines, compared with $10.15 in 1937, a recent low of $9.28 in 1933, and a high of $19.51 in 1920. Prices vary according to particle size, fine material suitable only for contact use being relatively cheap. The Engineering and Mining Journal quotations for Georgia or Florida earth, f. o. b. mines, have remained unchanged for several years at $14.50 per short ton for 30- to 60-mesh, $14 per ton for 15- to 30-mesh, $10 for 200-mesh up, and $7 for 100-mesh up.

Experiments with bauxite begun in 1937, for decolorizing oils by percolation processes, were extended in 1938; at least three companies are offering it as a substitute for fuller's earth—the Porocel Corporation (260 South Broad Street, Philadelphia, Pa.), the Floridin Co. (Warren, Pa.), and Max B. Miller & Co., Inc. (50 Church Street, New York, N. Y.). It is significant that all these companies (or their affiliates) also produce fuller's earth and the Porocel Corporation is jointly interested also in the production of activated earth. The new process seems applicable only to oils of the paraffinic type and those that can be made paraffinic but is being used in at least 10 refineries in Pennsylvania and Mid-Continent oil fields. The main advantage of bauxite is that it can be revivified indefinitely, whereas fuller's earth loses its efficiency and must be discarded after 20 burnings.[5]

On the other hand, new uses for fuller's earth may be developing in water purification. According to Weir,[6] the regular use of 20 pounds of clay costing about 10 cents per million gallons, with alum applications, has increased the efficiency of water treatment in Atlanta, Ga., 10 to 30 percent. At Chester, Pa., 43 pounds of clay costing 35 cents were used successfully for treating oily trade waste waters. The clay produces a heavy floc that reduces putrescence, odors, and even coliform bacteria. The United States has some 10,000 water-treatment plants, supplying about 65 million people with 5 billion gallons of water a day, thus indicating a daily demand of 50 to 100 tons of clay or roughly 10 percent of the quantity of fuller's earth now being consumed. However, about 300 tons of activated carbon are consumed daily in removing unpleasant odors and tastes from water; and if clay could be used instead of carbon, or even as an adjunct

[4] Oil, Paint, and Drug Reporter, Feb. 13, 1939, p. 33.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 8, No. 1, Jan. 20, 1939, p. 3.
[6] Weir, Paul, Use of Bleaching Clays in Water Purification: Am. Inst. Min. and Met. Eng. Tech. Pub. 1018 (Min. Technol., vol. 3, No. 1, January 1939), 11 pp.

thereto, the potential demand might be of the order of 1 million tons or more yearly (as it takes 10 to 50 times as much clay as carbon).

The adsorptive power of fuller's earth of the Georgia-Florida type (montmorillonite) itself is being increased 20 percent by an extrusion treatment. The moistened clay is pugged (kneaded) and then forced through slots, very much as common brick are formed in an auger machine. This process not only makes a better product but permits virtually complete recovery of all the clay in granular form suitable for percolation methods of oil refining, thereby enhancing its value further.

Fuller's earth sold by producers in the United States, 1936–38, by States

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
Florida and Georgia	139,376	$1,426,346	131,100	$1,441,588	91,031	$987,391
Nevada	(1)	(1)	4,485	51,718	5,984	57,499
Texas	46,855	462,656	49,500	473,408	37,998	358,980
Other States [2]	44,583	375,976	41,080	329,380	35,839	303,999
	230,814	2,264,978	226,165	2,296,094	170,852	1,707,869

[1] Included under "Other States."

[2] 1936: California, Colorado, Illinois, Indiana, Massachusetts, Nevada, and New Jersey; 1937-38: California, Colorado, Illinois, Mississippi, and Tennessee.

MISCELLANEOUS CLAY

Clay utilized for making common brick, sewer pipe, and other clay products ordinarily is not included in Bureau of Mines statistics. It comprises probably 90 percent of all clay dug; but little of it is merchant clay, as most of it is fabricated at integrated plants situated close to the pits. The bulk of the "miscellaneous clays" reported by the Bureau of Mines, however, falls in this category, which also includes some of the clay used as a blending material for portland cement and such rotary oil-well-drilling muds as do not fall in the bentonite class. Virtually the entire miscellaneous group is composed of clays worth not more than about $1 a ton, although a few specialties, such as slip clay, are valued much higher. A large part of the California drilling mud formerly classed as bentonite is now known to be of a different character and is classified as miscellaneous clay.

Miscellaneous clay, including slip clay [1] and shale, sold by producers in the United States, 1935–38

State	1935		1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
California	57,670	$61,144	149,152	$239,277	153,315	$217,938	135,923	$374,166
Colorado	23,142	19,267	53,381	47,643	65,190	58,916	54,115	49,249
Indiana	15,657	11,646	12,980	10,593	10,024	6,405	3,089	1,692
Iowa	-------	-------	-------	-------	(2)	(2)	6,055	36,725
Nebraska	-------	-------	(2)	(2)	(2)	(2)	16,009	7,532
Ohio	(2)	(2)	(2)	(2)	5,259	12,380	47,226	28,751
Pennsylvania	21,401	21,767	43,211	109,228	50,208	53,481	39,196	23,136
Washington	4,950	4,397	26,831	52,920	21,071	45,118	11,901	10,638
Other States [3]	84,898	150,436	107,228	227,158	98,455	391,789	76,201	329,770
	207,718	268,657	392,783	686,819	403,522	786,027	389,715	861,659

[1] Includes slip clay as follows: 4,316 tons, valued at $25,839 in 1935 and 3,617 tons, $23,058 in 1936, from New York and Pennsylvania; 6,087 tons, $39,889 in 1937 and 2,227 tons, $13,955 in 1938 from Michigan and New York.

[2] Included under "Other States."

[3] Includes States indicated by "(2)," and Alabama, Arkansas. Connecticut, Georgia, Illinois, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Montana, Nevada, New Jersey, New Mexico, New York, North Dakota, Oklahoma, Tennessee, Texas, Utah, Virginia, and Wisconsin.

HEAVY-CLAY PRODUCTS

In February 1938 shipments of common brick turned upward after declining steadily for 9 months, but the rise was moderate and total shipments probably were much less than in 1937. Employment in brick, tile, and terra cotta works in the United States confirmed the apparent uptrend, the 1938 pattern being almost the reverse of that of the preceding year. Stocks increased in 1937 but were much reduced in 1938, contributing further to the more optimistic viewpoint at the year end. As is shown by the usual indexes based upon 1923–25 averages, however, these industries still lag behind other building-material industries and far behind the recovery in general factory employment and production.

The Bureau of the Census reports that in 1937 the value of all clay products made in the United States, exclusive of pottery and nonclay refractories, was $159,853,658 compared with $136,249,772 in 1936. For common brick alone the value rose from $30,108,170 to $34,009,775 and the quantity from 2,967 million in 1936 to 3,253 million in 1937. In 1925, the peak year, the production of common brick was 7,562 million worth $88,551,400.

PRICES

Available quotations for the several kinds of clays and fuller's earth have been summarized already in this chapter under the respective subheads. The average valuations of the specific groups as reported by producers are summarized in the following table:

Average values per short ton of various kinds of clay sold by producers in the United States, 1930–34 (average) and 1935–38

Year	Kaolin		Ball clay	Slip clay	Fire clay and stoneware clay	Bentonite	Fuller's earth
	United States	South Carolina					
1930–34 (average)	$6.44	$6.83	$7.16	$6.83	$2.59	$8.13	$10.62
1935	7.19	7.57	6.55	5.99	2.64	6.65	9.79
1936	7.10	7.53	6.87	6.37	2.48	7.69	9.81
1937	7.31	8.16	7.33	6.55	2.58	7.71	10.15
1938	7.97	8.75	7.79	6.27	2.78	7.15	10.00

CONSUMPTION AND USES

The real magnitude of the industries of the United States that depend on clay is not revealed by Bureau of Mines figures. Not only do they exclude the raw clay used in making common brick, hollow building blocks, and other heavy-clay products but also, even for plants where the tonnages and value of raw clay is reported, they fail to show the value of the fired clay articles that are the real products sold.

Moreover, some of the clays used locally for pottery making may not be reported at all, not even in respect to their estimated value as raw clay. In California, for example, a wide variety of fire clays and miscellaneous clays, as well as kaolin, can be grouped in the general classification of pottery clays, being used in the manufacture of red and brown earthenware; china and sanitary ware; flower pots; floor, faience, and ornamental tiling; architectural terra cotta; and similar products. As pointed out by State Mineralogist Bradley,[7] of California, the output of "pottery clay" in that State alone in 1936 was 382,823 tons, worth only $646,920, whereas products manufactured from this clay were worth $9,886,209.

The accompanying table, which shows sales of specified domestic clays by kinds and uses in 1937, continues a series begun in 1921. Since it does not include imported clays and since domestic clays have displaced imported clays more and more, the data for different years are not accurately indicative of consumption or even strictly comparable. This is especially true in respect to the total consumption of china clay in hotel china, sanitary ware, electrical porcelain, and coating paper, the industries in which English clays have been chiefly used. Minor displacements have occurred in other lines.

Sales of fuller's earth are shown in a separate table because the uses other than for refining oils and fats, although increasing, are relatively small.

Clay (excluding fuller's earth) sold by producers in the United States in 1938, 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.	40,052	75,647	911	----------	----------	116,610
Chemical stoneware	----------	----------	18,549	----------	----------	18,549
Stoneware	----------	----------	27,459	----------	----------	27,459
Art pottery	228	195	2,021	----------	19	2,463
Flowerpots	----------	----------	615	----------	6,650	7,265
Slip for glazing	----------	----------	----------	----------	574	574
	40,280	75,842	49,555	----------	7,243	172,920
Tile, high-grade	11,785	16,005	3,033	----------	257	31,080
Kiln furniture, etc.:						
Saggers, pins, stilts	1,335	132	28,872	----------	----------	30,339
Wads	----------	----------	7,174	----------	----------	7,174
	1,335	132	36,046	----------	----------	37,513
Architectural terra cotta	----------	935	13,303	----------	890	15,128
Paper:						
Filler	291,359	----------	1,621	----------	----------	292,980
Coating	71,020	----------	----------	----------	----------	71,020
	362,379	----------	1,621	----------	----------	364,000
Rubber	70,799	----------	4,960	----------	----------	75,759
Linoleum and oilcloth	4,751	500	6,611	----------	1,780	13,642
Paints:						
Filler or extender	4,294	436	1,461	----------	353	6,544
Kalsomine	3,565	----------	----------	----------	----------	3,565
	7,859	436	1,461	----------	353	10,109
Cement manufacture	34,238	----------	1,666	676	30,660	67,240
Refractories:						
Firebrick and block	35,951	300	742,382	----------	----------	778,633
Bauxite, high-alumina brick	----------	----------	10,848	----------	----------	10,848
Fire-clay mortar, including clay processed for laying firebrick	1,662	----------	143,578	----------	30	145,270
Clay crucibles	----------	----------	584	----------	----------	584
Glass pots	----------	58	523	----------	----------	581
Other glass refractories	94	----------	3,111	----------	----------	3,205
Zinc retorts and condensers	----------	----------	8,225	----------	----------	8,225
Foundries and steel works	3,160	----------	297,072	32,627	11,241	344,100
	40,867	358	1,206,323	32,627	11,271	1,291,446

[7] Bradley, W. W., California's Commercial Minerals: Mining Congress Jour., vol. 24, No. 9, September 1938, p. 18.

Clay (excluding fuller's earth) sold by producers in the United States in 1938, by kinds and uses, in short tons—Continued

Use	Kaolin	Ball clay	Fire clay and stoneware clay	Bentonite	Miscellaneous clay including slip clay	Total
Miscellaneous:						
Rotary-drilling mud				47,093	114,467	161,560
Filtering and decolorizing oils (activated earths)				90,028	(1)	90,028
Artificial abrasives		2	611		1,653	2,266
Asbestos products	338		844			1,182
Chemicals	1,850		84			1,934
Enameling		725	221			946
Plaster and plaster products	3,762		634			4,396
Heavy clay products	60	3	123,300		188,792	312,155
Other uses	14,751	30	8,668	21,759	[2] 32,349	77,557
	20,761	760	134,362	158,880	337,261	652,024
Grand total, 1938	595,054	94,968	1,458,941	192,183	389,715	2,730,861
1937	732,282	121,470	2,785,344	194,768	403,522	4,237,386

[1] Included under "Other uses."
[2] Includes tonnage indicated by (1) above.

Fuller's earth sold or used by producers in the United States, 1934–38, 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
1934	201,902	$1,894,140	16,281	$176,611	2,081	$14,330	220,264	$2,085,081
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

TECHNOLOGY

No longer content with even the best clay that nature provides, consumers are now getting processed clays whose properties not only are definitely controlled but also can be modified within wide limits. There is growing evidence to show that whiteness, opacity, and other characteristics of a good coating clay depend to an astonishing degree on fineness. Two American companies are employing Bird's solid-bowl continuous centrifuge, with or without electrophoretic attachment, to effect exact control of particle size. A coating clay made by this process contains no particles over 2 microns in size, and any desired fractionation can be accomplished with precision. Certain paper-filling clays that ordinarily would be worth $7 a ton yield, by this low-cost treatment, a fair proportion of these superquality clays worth $15 to $80 a ton, the coarser fractions still being usable as filler clays. Bleaching, too, has become a fine art that can be accomplished with scientific exactitude. Instead of merely neutralizing cream tints with bluing, the offending iron can be removed in large part from many clays by wet treatment with hydrosulfite or a combination of zinc and sulfurous acid. Other clays are gray due to carbon or organic matter removable sometimes by heating (though this may ruin the structure of a paper clay), or possibly by froth flotation. Of equal importance to paper makers are the newly developed methods for determining quickly the quality of a given coating material. Using the color analyzer built by Prof. Arthur C. Hardy of the Massachusetts Institute of Technology, reflectance of a given sample can be plotted directly over the whole spectrum in 5 minutes. Properly processed

Georgia clays show an average reflectance of close to 90 percent of the standard magnesia button for virtually all wave lengths within the visible range. No means has yet been discovered commercially to eliminate the depression in the shorter wave-lengths due to titanium, but the sharp valley due to absorption by iron oxides can be smoothed out almost completely by suitable beneficiation.

National Bureau of Standards tests [8] on 45 experimental papers with different filling and sizing material show that for the same pulp furnish, the smoothness values were about the same for precipitated calcium carbonate and clay, and less for natural calcium carbonates, titanium dioxide pigments, and zinc sulfide pigments. With respect to their influence on the oil penetrability of the paper, the order in decreasing rapidity of penetration was: Precipitated calcium carbonate, natural calcium carbonate, zinc sulfide pigments, titanium dioxide pigments, and clay. The fillers ranked in this latter order also in respect to the degree to which they increase air permeability.

Another National Bureau of Standards report [9] relates to pressures for extruding clays and late trends in clay products manufacture have been reviewed comprehensively by Hursh.[10]

Processing of Illinois weathered glacial clay to provide good-quality oil-well drilling mud, bond clays, and bleaching clays is reported [11] as offering commercial possibilities.

Everyone knows what clay is, yet no one has been able to define it satisfactorily. Not only do most clays comprise a variety of minerals, but the same minerals do not always exhibit the same properties. Plasticity, generally cited as the chief characteristic of clays, is almost absent from some kaolins whose composition, mineralogically and chemically, corresponds exactly with what once was assumed as being "typical clay substance." On the other hand, other substances that no one would think of calling clay become plastic when suitably handled and worked. Reporting a lecture by Sir William Bragg, Searle [12] has reviewed the present knowledge of the structure of clays, with special emphasis upon new developments in X-ray examination. On this basis clays are divided into only two groups, (1) those allied to halloysite, kaolinite, nacrite, and dickite; and (2) those allied to pyrophyllite—including montmorillonite, beidellite, bentonite, and fuller's earth (which differ in metal content). In both complex silicates and clays, he says, the atoms (oriented at the apexes of tetrahedra) form a pattern of rectangular units, and the various sheets or layers must fit perfectly in combination even though they may differ slightly in separate existence. The suggested structures explain the colloidal properties of the smallest clay particles, the relatively enormous effect of minute additions of alkalis or acids to clay pastes and suspensions, and they go far to explain variations in plasticity. The "cause of plasticity," according to Sir William Bragg, is the entry of water molecules into the unit cells. The effect of this entry on the clay lattice is to increase the *c* axis without altering the *a* and *b* axes, opening it up like an accordion. This water acts as a lubricant,

[8] Shaw, M. B., and Simmons, R. H., Printing Tests of Experimental Book Papers: Nat. Bureau of Standards Jour. Research, vol. 22, No. 3, March 1939, pp. 285–294 (Research Paper 1180).

[9] Shull, R. T., and Johnson, P. V., Relation Between Moisture Content and Flow-Point Pressure of Plastic Clay: Nat. Bureau of Standards Jour. Research, vol. 22, No. 3, March 1939, pp. 329–337 (Research Paper 1186).

[10] Hursh, R. K., New Developments in the Processing and Forming of Clay Products: Illinois State Geol. Survey Circ. 33-c, 1938, pp. 19–25.

[11] Lamar, J. E., Grim, R. E., and Grogan, R. M., Gumbotil as a Potential Source of Rotary Drilling Mud, Bonding Clay, and Bleaching Clay: Illinois State Geol. Survey Circ. 39 (Mines), July 15, 1938, 23 pp.

[12] Searle, A. B., Clay: Nature, vol. 141, No. 3570, Apr. 2, 1938, p. 583.

allows the clay particles to move easily without loss of shape or mass.

The peculiar ability of some clays to absorb water molecules and to arrange them in successive sheets in the layerlike structure of the clay crystal itself also may explain the property of "base exchange" of some derivatives of montmorillonite clays (zeolites). In spite of their complexity, the aluminosilicates can be classed in three simple groups, according to whether the structure is (1) fibrous, (2) micaceous, or (3) framework. The first (compare fibrous zeolites) has rigid molecular binding in only one direction, like rope strands that can be pulled apart easily in two directions. The second group has rigid binding in two directions but not in the third; its members split easily into thin sheets, frequently spontaneously in liquids. Mica, talc, the bentonites, pyrophyllite, and even kaolinite have been classed as micaceous minerals, and their platy cleavage results naturally from this structure. The third group has rigid binding in all directions. It does not follow, however, that the framework is always compact and impermeable; in fact it may be so open and porous that ions flow in and out, as in certain zeolites. All three types of structure are found in clays, shales, and surface soils; but in the finer grain sizes, micaceous types predominate and tend to determine the behavior of the mixture. Ross and Kerr distinguish four groups of clay minerals (1) kaolin group, (2) montmorillonite (bentonite) group, (3) potassium-bearing clays, and (4) a more evasive group occurring in shales. However, real structural data, as outlined by Sir William Bragg, appear to be available only for the first group.

A new concept for the transition of colloidal clay sols to gels has been prepared by the discoverer of Alsifilm, the mica substitute.[13]

NEW PLANTS

New construction trends during 1938 have been summarized as follows:[14]

The Louisiana Boganite Corporation recently completed a new plant at Bogalusa, La., for the production of drilling mud and filter and bleaching clays. The equipment in this modern new plant includes a 40-ft. rotary drier, a Williams hammer-mill, a Raymond 5-roller high-side mill with a Whizzer separator, a Raymond flash-drying system, etc.

A new plant with two Gruendler hammer-mills was built by the Georgia Coating Clay Co. at Macon, Ga. Louisville driers and Raymond equipment were also installed in this plant, and in the new plants of the Sgoda Corporation at Phillips, Ga., and the Champion Paper & Fiber Co., at Sandersville, Ga. A new oil-well clay plant with a Raymond mill was built by the Beaumont Cement Sales Corporation at Villa Platte, Tex. Quality Earths, Thomasville, Ala., built a new plant. New equipment in the plant of the Filtrol Corporation, Jackson, Miss., includes a Research Corporation Cottrell precipitator, a Raymond mill, a Jeffrey hammer-mill, and other equipment. The California Kaolin Co. plans to erect a $10,000 plant at Lone Pine, Cal. The Earthen Products Co., Houston, Tex., completed a $25,000 reequipment and expansion program.

In Minerals Yearbook 1938 (p. 1122) it was recorded that the new plant of the Tennessee Bleaching Clay Corporation at Paris, Tenn., had been burned in 1937; it was rebuilt subsequently and operated in 1938.

[13] Hauser, E. A., and LeBeau, D. S., Studies of Gelatin and Film Formation of Colloidal Clays: Jour. Phys. Chem., vol. 42, No. 7, October 1938, pp. 961-969.

[14] Pit and Quarry, Gypsum, Phosphate, Feldspar, Other Groups Record Important Advances: Vol. 31, No. 7, January 1939, p. 76.

ABRASIVE MATERIALS

By Bertrand L. Johnson and M. Schauble

SUMMARY OUTLINE

The abrasive materials industry followed general decline in activity that characterized 1938. The aggregate values of both natural and artificial abrasives sold in 1938 were considerably less than in 1937, although trends in the values of individual abrasives were mixed. There were marked declines in the values of diatomite, tripoli, ground sand and sandstone, grindstones and pulpstones, millstones, garnet, and emery in 1938 compared with 1937. Increased values were shown, however, for quartz, oilstones and related products, and pumice and pumicite. The value of imports of abrasives was off 36 percent from 1937 and the value of exports, 7 percent.

Salient statistics of abrasives industries in the United States, 1937–38

	1937	1938	Percent of change in 1938
Domestic production (sold or used by producers):			
Natural silica abrasives:			
Diatomite	[1] $1,459,118	[1] $1,459,118	
Tripoli	450,570	329,081	−27.0
Quartz	66,041	88,197	+33.5
Ground sand and sandstone	1,996,528	1,425,445	−28.6
Special silica stone products:			
Grindstones and pulpstones	572,708	240,006	−58.1
Oilstones and related products	112,841	130,277	+15.5
Millstones	8,305	3,743	−54.9
Flint lining and grinding pebbles	(2)	(2)	
Natural silicate abrasives:			
Pumice and pumicite	301,936	312,886	+3.6
Garnet	382,535	191,658	−49.9
Natural alumina abrasives:			
Emery	2,780		
Total natural abrasives	[3] 3,894,244	[3] 2,721,293	−30.1
Total artificial abrasives [4]	8,364,587	6,238,034	−25.4
Foreign trade:			
Imports	7,418,172	4,727,004	−36.3
Exports	1,160,089	1,075,070	−7.3

[1] Average for 1936–38, 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.
[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 principally for abrasive purposes, although those mentioned later under "Miscellaneous abrasive materials" are not included in the statistics given herein. Several commodities listed as abrasive materials for which statistical data are given also have important nonabrasive uses.

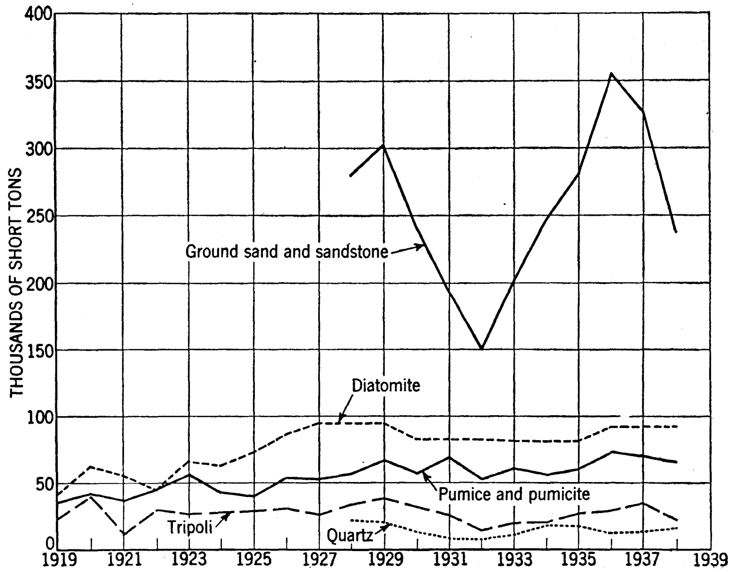

FIGURE 1.—Trends in production of diatomite, tripoli, pumice and pumicite, quartz, and ground sand and sandstone, 1919–38.

A general review of the abrasives industry in 1937 by Eardley-Wilmot [1] appeared in 1938.

NATURAL SILICA ABRASIVES

Diatomite.—The Bureau of Mines has not been at liberty to publish annual production figures on diatomite since 1926. Production data for 3-year periods, however, may be shown, and the averages for the 3-year periods since 1926 are plotted in figure 1. The trend in sales of diatomite in the immediate predepression years was upward, reaching an all-time peak in 1929. Total sales for the 3-year period 1927–29 were 286,426 short tons. Sales in the next two periods declined, but in 1936–38 they recovered to 279,645 tons—not quite the predepression level. Sales in 1938 were considerably less than those in 1937, but even in 1937 they did not reach the level of the all-time peak year 1929 or of 1930.

The greater part of the domestic production of diatomite comes from the Western States. California continued in 1938 to be the chief source, but sales were reported also in other Western States (Idaho, Nevada, Oregon, and Washington), as well as in Florida and New York. The following table presents such data on diatomite sales from 1933 to 1938 as the Bureau of Mines may publish.

[1] Eardley-Wilmot, V. L.: Mineral Industry for 1937, McGraw-Hill Book Co., New York, vol. 46, 1938.

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.

A review of the diatomite industry during 1937 appeared early in 1938.[2] The fresh-water diatomite deposits of the Pacific Coast region were described by Mulryan [3] in a recent publication. Deposits of fresh-water diatoms occur in commercial quantities in California, Oregon, Washington, Idaho, Nevada, and Arizona. In general they are associated with volcanic activity of late Tertiary or Pleistocene time. The deposits are roughly circular, with their maximum thickness at the center. Some of the older dry deposits are horizontal; others tilt as much as 50°. Deposits also are found in present-day lakes. Ordinarily these diatomite deposits are composed essentially of types of diatoms that produce the heavier powders, their uses being limited to polishes, fillers, admixtures, and insulation products. The chief exception is the Terrebonne deposit from which filtration powders are also produced.

Tripoli.—Sales of tripoli (including Pennsylvania rottenstone) in 1938—the lowest since 1934—decreased more than 12,000 tons from 1937 and reversed the rising trend from the 1934 low point through 1937. Sales in 1938 were only 22,188 short tons valued at $329,081. Tripoli was produced in Arkansas, California, Illinois, Missouri, Oklahoma, and Tennessee. The Missouri-Oklahoma and Illinois districts were the principal producing areas. Rottenstone was produced only in Pennsylvania. Figure 1 shows the trend of the industry in recent years. The following table gives the data for tripoli from 1934 to 1938.

Tripoli (including Pennsylvania rottenstone) sold or used by producers in the United States, 1934–38

Year	Illinois		Other States [1]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	7,417	$119,418	13,112	$209,938	20,529	$329,356
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

[1] 1934: Arkansas, California, Georgia, Missouri, Oklahoma, Pennsylvania, and Tennessee; 1935: Arkansas, California, Georgia, Missouri, Oklahoma, and Pennsylvania; 1936: Arkansas, California, Missouri, Oklahoma, and Pennsylvania; 1937–38: Arkansas, California, Missouri, Oklahoma, Pennsylvania, and Tennessee.

Of the domestic tripoli sold in 1938, 36.5 percent was for abrasive uses, but in some years, such as 1936, as much as 60 percent has been so used. The second largest use has been for fillers, which took 8,363 tons in 1937 but only 5,584 tons (25 percent of the total) in 1938. The

[2] Eardley-Wilmot, V. L., Work cited in footnote 1.
[3] Mulryan, Henry, Fresh-water Diatomite in the Pacific Coast Region: Am. Inst. Min. Met. Eng. Tech. Pub. 1057, May 1939, 8 pp. (Read at Los Angeles Meeting, October 1938.)

following table gives the quantity and value of tripoli and rottenstone sold or used by producers and classified by them according to uses.

Tripoli sold or used by producers in the United States in 1938, by uses

Use	Producers reporting	Short tons	Value	Percent of total	
				Quantity	Value
Abrasives	8	8,097	$138,807	36.5	42.2
Concrete admixture	3	2,170	12,634	9.8	3.8
Filler	4	5,584	78,900	25.2	24.0
Miscellaneous [1]	5	6,337	98,740	28.5	30.0
	[2] 10	22,188	329,081	100.0	100.0

[1] Includes tripoli used for filter block, foundry facing, and other unspecified uses.
[2] A producer reporting more than one use is counted only once in arriving at total.

The tripoli deposits of western Tennessee and Mississippi, characteristics of the tripoli, technology, and possible uses were described in a report [4] published early in 1938.

Quartz.—Sales of crude, crushed, and ground quartz from pegmatite dikes, veins, and quartzite beds were decidedly greater both in quantity and value in 1938 than in 1937. The quantity sold was greater than in any year since 1929. The average value per ton, however, fell from $5.08 in 1937 to $4.74 in 1938. Figure 1 shows the trend in sales of quartz in recent years. The greatest increase in tonnage was in crushed quartz, but the greatest increase in value was in the higher-priced ground quartz. Sales of ground quartz, although higher than in 1937, recovered little of their slump since the high sales of 1934. Massachusetts, Oregon, and Wisconsin produced quartz in 1938, in addition to the States that were productive in 1937.

Data on sales of quartz by kinds from 1934 to 1938 and by States from 1936 to 1938 are shown in the following tables.

Quartz (crude, crushed, and ground)[1] sold or used by producers in the United States, 1934–38

Year	Crude		Crushed		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	[2] 4,447	[2] $16,168	(2)	(2)	13,846	$113,797	18,293	$129,965
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

[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."

[4] Spain, E. L., Vestal, F. E., Davis, F. A. W., and Johnson, Martin, Tripoli Deposits of Western Tennessee and Mississippi: T.V.A., Water Control Planning Dept., Geol. Div. Geol. Bull. 8, Knoxville, Tenn., February 1938, 18 pp.

Quartz (crude, crushed, and ground)[1] *sold or used by producers in the United States, 1936–38, by States*

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
California	(2)	(2)	746	$6,072	1,494	$20,809
Maine and New Hampshire			96	243	243	663
Maryland	525	$7,155	410	5,850	377	6,000
Massachusetts					140	840
North Carolina	1,005	11,398	792	6,261	} 763	} 9,390
Virginia			369	1,063		
Undistributed [3]	11,456	78,039	10,599	46,552	15,594	50,495
	12,986	96,592	13,012	66,041	18,611	88,197

[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] 1936: Arizona, California, New Jersey, New York, Ohio, and Tennessee; 1937: Arizona, New York, Ohio, and Tennessee; 1938: Arizona, New York, Ohio, Oregon, Tennessee, and Wisconsin.

Ground sand and sandstone.—Both the quantity and value of sales of ground sand and sandstone declined sharply in 1938 from those in 1937. Sales totaled only 237,167 short tons valued at $1,425,445 in 1938 compared with 328,156 tons valued at $1,996,528 in 1937. The larger producing States are usually Illinois, New Jersey, Ohio, and Pennsylvania.

The following tables give the sales of ground sand and sandstone from 1934 to 1938 for the United States as a whole and in 1937 and 1938 for such States as can be shown.

Ground sand and sandstone sold or used by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	248,026	$1,392,173	1937	328,156	$1,996,528
1935	281,665	1,678,295	1938	237,167	1,425,445
1936	356,423	2,146,464			

Ground sand and sandstone sold or used by producers in the United States, 1937–38, by States

State	1937		1938	
	Short tons	Value	Short tons	Value
Illinois	96,329	$575,251	66,583	$418,881
Massachusetts	2,613	12,448	1,234	4,102
New Jersey	82,398	430,743	63,968	338,195
Ohio	37,935	296,649	28,540	177,876
Undistributed [1]	108,881	681,437	76,842	486,391
	328,156	1,996,528	237,167	1,425,445

[1] 1937: California, Missouri, North Carolina, Pennsylvania, Virginia, West Virginia, and Wisconsin; 1938: California, Missouri, Pennsylvania, Virginia, West Virginia, and Wisconsin.

Figure 1 shows the trend in production of ground sand and sandstone.

The quantities of ground sand and sandstone sold for different uses in 1938 and their total and average value per ton for each use are listed in the following table. Data for sales by uses from 1936 to 1938, inclusive, show that the "pottery, porcelain, and tile" industry is by far the leading market with the abrasive industry in second place in each of these 3 years. Other important uses are in foundry operations, in enamel manufacture, and as a filler.

Ground sand and sandstone sold or used by producers in the United States in 1938, by uses

Use	Short tons	Value	
		Total	Average per ton
Glass	7,306	$38,097	$5.21
Foundry	22,413	134,158	5.99
Pottery, porcelain, and tile	93,790	631,592	6.73
Enamel	10,784	63,360	5.88
Cleansing and scouring compound	62,439	308,926	4.95
Other abrasive use	543	5,933	10.93
Filler	8,878	43,741	4.93
Other	31,014	199,638	6.44
Total reported by uses	237,167	1,425,445	6.01

Abrasive sand.—Abrasive sands are hard sands with a high percentage of silica. They include all natural sands used for abrasive purposes, such as sawing stone, grinding glass, making sandpaper, and sandblasting. Sales in recent years have followed the general industrial trend from a peak in 1929 to a low in 1932 and a recovery to 1,067,178 short tons valued at $1,440,736 in 1937. Statistics for 1938 and the relationships of abrasive sand to the rest of the sand and gravel industry are shown in the chapter on Sand and Gravel in this volume.

Schwalbe,[5] in an article in Glass Industry, describes the processing, at the River Rouge plant of the Ford Motor Co., of raw Manistee Beach sand from Lake Michigan and the continuous grading and classification of the grinding sand by grain size.

SPECIAL SILICA STONE PRODUCTS

Grindstones and pulpstones.—The total value of grindstones and pulpstones sold by producers in the United States in 1938 ($240,006) was less than in any year since 1895, when only $205,768 worth was sold. The tonnage and value of grindstones sold in 1938 were lower than in any year since 1914 when they were first shown separately. The value of pulpstones sold in 1938 was less than in any year since 1932.

Natural grindstones were produced in northeastern Ohio and western West Virginia in 1938 and pulpstones in West Virginia and Washington.

[5] Schwalbe, F. G., Grading and Reclaiming Grinding Sand: Glass Ind., vol. 19, No. 6, June 1938, pp. 207-212.

The following table gives sales of these materials from 1934 to 1938, inclusive.

Grindstones and pulpstones sold by producers in the United States, 1934–38

Year	Grindstones		Pulpstones		
			Quantity		Value
	Short tons	Value	Pieces	Equivalent short tons	
1934	9,781	$285,603	760	2,849	$177,631
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

Oilstones and related products.—The demand for sharpening stones of various types was markedly less in 1938 than in 1937; consequently, sales of oilstones and related products were lower than in 1936 and 1937, but remained above those of the depression years, 1931 to 1935. Several States helped meet the demand: Arkansas furnished novaculite for oilstones and whetstones; Indiana and Ohio sandstone for oilstones, scythestones, and whetstones; New Hampshire schist for scythestones; and Indiana fine-grained sandstones for manufacture into rubbing stones.

The following table shows the sales of oilstones and related products from 1934 to 1938.

Oilstones and other whetstones, hones, scythestones, and rubbing stones sold by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	396	$94,419	1937	810	$112,841
1935	439	105,589	1938	511	130,277
1936	752	121,196			

Millstones.—The value of natural millstones sold in the United States in 1938 dropped to the lowest point reached in the 59 years for which the statistics of production of millstones have been recorded. This value, $3,743, was less than half that of sales in 1937. Sales in 1938 were confined to two States—New York with four producers and Virginia with two. American millstones have been made, for the most part, of quartz sandstones and conglomerates. As in recent years, production in 1938 was confined to millstones of these types—the "Esopus" stone from the Shawangunk conglomerate in Ulster County, N. Y., and the "Brush Mountain" fine-grained quartzite from Brush Mountain, Montgomery County, Va.

The following table gives the annual production data for natural millstones and related products from 1934 to 1938.

Value of millstones, chasers, and dragstones sold by producers in the United States, 1934–38

Year	New York		Other States[1]		Total	
	Producers	Value	Producers	Value	Producers	Value
1934	5	$3,381	3	$6,720	8	$10,101
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

[1] 1934–35: North Carolina and Virginia; 1936–38: Virginia.
[2] Bureau of Mines not at liberty to publish figures.

Flint lining and grinding pebbles.—The moderate, continuous domestic demand for noncontaminating grinding materials for use in certain mineral-processing industries requiring a product with a minimum iron content has been met in recent years partly by one or two domestic producers and partly by imports.

In 1938 sales of domestic liners, which were less than in 1937, were reported only by the Jasper Stone Co., Sioux City, Iowa, the material marketed being quartzite quarried near Jasper, Rock County, Minn. Sales of quartzite pebbles by this company also were less than in 1937. A new producer, the King Solomon Mines Co., Black Bear (near Yreka), Siskiyou County, Calif., mined and used a considerable tonnage of ball-mill pebbles in its gold mill.

Flint grinding pebbles occur in the beaches derived from flint-bearing chalk cliffs on both the English and French coasts of the English Channel and on the islands off the coast of Denmark. France and Denmark are the only flint-pebble exporting countries, as the English production is insufficient for its own needs. Flint grinding pebbles are imported into the United States from both Denmark and France.

NATURAL SILICATE ABRASIVES

Pumice and pumicite.—Sales of pumice and pumicite in 1938 were lower in quantity than in 1937 but were somewhat higher in value. Figure 2 shows the trend in sales of pumice and pumicite in recent years for various uses, and the following table gives the values of the total annual sales from 1934 to 1938.

Pumice and pumicite sold or used by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	56,169	$207,058	1937	71,007	$301,936
1935	60,000	247,076	1938	65,742	312,886
1936	72,915	328,406			

Landes[6] has described the age, origin, distribution, and reserves of pumicite (volcanic ash) in the Great Plains, Cordilleran, and Pacific Coast regions of the United States and in the individual States. Volcanic ash is the finest material ejected from volcanoes. Larger, highly cellular, glassy ejecta are termed "pumice." Inasmuch as

[6] Landes, K. K., Distribution of Volcanic Ash; Bull. Am. Ceram. Soc., vol. 17, No. 8, August 1938, pp. 323–325.

volcanoes have been active in the West during many geologic periods, deposits of volcanic ash or its alteration products are found in the rocks of many ages. Most of the volcanic ash in the Cretaceous and older rocks has been altered to bentonite. Unchanged volcanic-ash deposits, however, occur in Tertiary, Pleistocene, and Recent strata. Most of the ash marketed today comes from Pleistocene deposits and the rest from Tertiary. The Pleistocene deposits of volcanic ash of the Great Plains occur in many distinct and separate deposits in protected dune areas. Most of the Tertiary ash, however, fell in

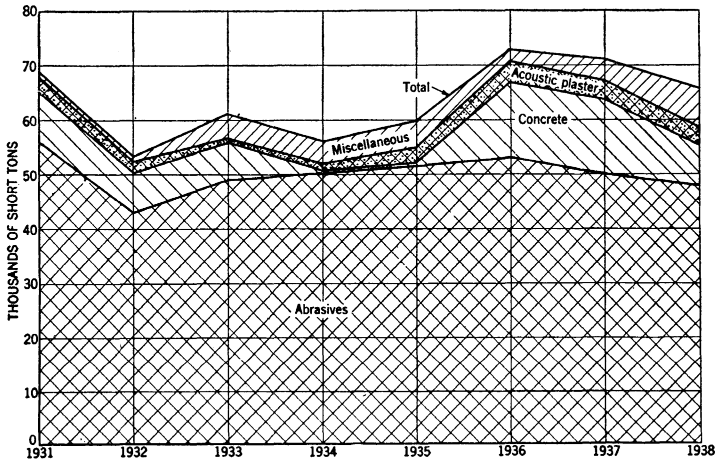

FIGURE 2.—Trend, by uses, of pumice and pumicite sold or used by producers in the United States, 1931–38.

large interior lakes, where it is interbedded with other sediments. The source volcanoes for the Pleistocene volcanic ash are thought to be members of the Capulin group in northeastern New Mexico. The Tertiary ash beds of the Great Plains area probably originated through volcanic activity in the Cordilleran area. The volcanic-ash deposits within the Cordilleran and Pacific Coast areas doubtless resulted from volcanism in those regions. Present exploitation is not making serious inroads on the immense reserves of these materials.

Pumicite (volcanic ash) was produced in 1938 in Kansas, Nebraska, and Oklahoma in the Great Plains area and in California and Oregon in the Pacific Coast region. Lump pumice was produced in the latter region only—in California and Oregon. A volcanic-tuff [7] deposit at Grants, N. Mex., was exploited in 1938 and the product ground and marketed as domestic pumice.

The quantities of pumice and pumicite sold or used in 1938 for all specified uses (except miscellaneous) declined from 1937. The greater part of the total is sold for abrasive purposes, such as cleansing and scouring compounds and hand soaps. The demand for this use has been relatively constant in recent years—roughly around 50,000 tons a year—and in 1938 the quantity sold or used was 47,013 tons. Sales for the next most important use, concrete admixture and concrete aggregate, after rising abruptly from a few hundred tons in 1935 to nearly 14,000 tons in 1936 and 1937, were curtailed to 7,596 tons in 1938. (See fig. 2.)

[7] Landes, K. K., Work cited in footnote 6.

Pumice and pumicite sold or used by producers in the United States, 1937–38, by uses

Use	1937			1938		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Cleansing and scouring compounds and hand soaps	48,608	$193,559	$3.98	47,013	$188,807	$4.02
Other abrasive uses (unspecified)	1,442	17,369	12.05	938	8,499	9.06
Concrete admixture and concrete aggregate	13,839	23,650	1.71	7,596	18,297	2.41
Acoustic plaster	3,641	54,459	14.96	3,080	54,055	17.55
Miscellaneous uses [1]	3,477	12,899	3.71	7,115	43,228	6.08
	71,007	301,936	4.25	65,742	312,886	4.76

[1] 1937: Includes material used in asphalt, grading roads, chicken litter, filtering, rock gardens and landscaping, building tiles, floor sweep, and some unspecified uses; 1938: Includes material used in asphalt, filtering, rock gardens and landscaping, building tiles, and some unspecified uses.

The volcanic-ash deposits of Oklahoma were described in 1938 in a publication of the Oklahoma Geological Survey.[8] The manufacture of pumicite-concrete building blocks at Napa, Calif., by the Basalt Rock Co. was described in an article [9] published early in 1939.

In Iceland [10] crushed pumice stone mixed with cement is being employed for hollow building blocks for residential construction.

The use of volcanic ash as a ceramic raw material has not been extensive, although its practicability has been indicated both by laboratory and industrial applications. Plummer [11] described the effect of volcanic ash in glazes by comparing such glazes with those of nearly identical composition except that they contained feldspar or equivalent materials. The volcanic ash was used successfully in several types of glazes, replacing the feldspar and part of the flint and constituting in some glazes more than 50 percent of the total weight of the raw materials. No significant difference was noted between the volcanic-ash glazes and the control glazes except that the iron oxide colored the volcanic ash. Plummer considers that the use of volcanic ash to replace feldspar in glazes and glass batches offers a distinct economic advantage because of the low cost of this material and its finely divided natural condition, which should be of especial importance in colored glazes for roofing tile, wall tile, and low-priced pottery. The slight neutralization of the colors is said to give more pleasing effects in artware and ceramic sculpture.

Garnet.—The general decline in industrial activity in the United States in 1938 reacted on the sales of garnet, which in 1938 were only a little over half as large as in 1937. (See fig. 3.) Sales of abrasive garnet in 1938 were reported by four companies, but only three companies, one each in New York, New Hampshire, and North Carolina, mined garnet during 1938—the Barton Mines Corporation, North Creek, Warren County, N. Y.; Davenport Garnet Co., South Danbury, Merrimack County, N. H.; and the Celo Mines, Inc., Burnsville, Yancey County, N. C. The Warren County Garnet

[8] Beach, J. O., Volcanic Ash and Tripoli: Oklahoma Geol. Survey Mineral Rept. 1, 1938, 29 pp.
[9] Rockwood, N. C., Lightweight Building Unit and Cambered Shingle: Rock Products, vol. 42, No. 2, February 1939, pp. 63–65, 69.
[10] American commercial attaché, Copenhagen, Denmark, Pumice-cement Building Blocks: Bureau of Foreign and Domestic Commerce Construction Circ. 47, July 31, 1938, p. 9.
[11] Plummer, Norman, Ceramic Uses of Volcanic Ash: Bull. Am. Ceram. Soc., vol. 18, No. 1, January 1939, pp. 8–11.

Mills, Weaverton, Warren County, N. Y., sold garnet from stock. A little less than 2 tons of garnet were imported in 1938, the first imports of this material since 1933.

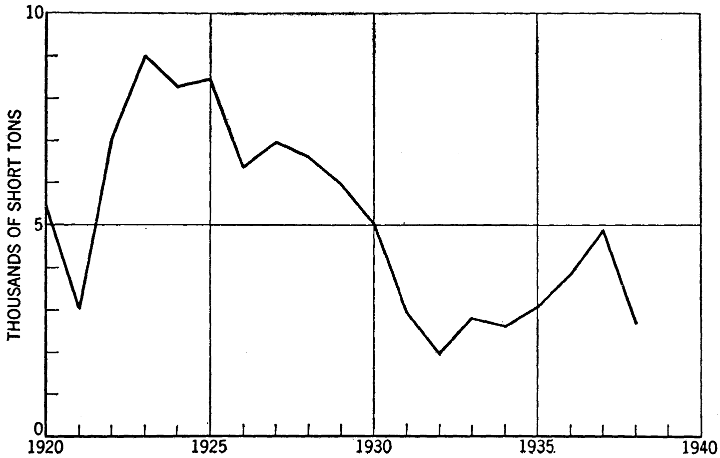

FIGURE 3.—Marketed production of abrasive garnet in the United States, 1920–38.

The following table shows the quantity and value of abrasive garnet sold or used by domestic producers since 1934.

Abrasive garnet sold or used by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	2,591	$214,815	1937	4,863	$382,535
1935	3,060	256,520	1938	2,669	191,658
1936	3,820	315,913			

During 1938 domestic demand arose for a very fine grained abrasive of the type represented by the Belgian razor honestone ("coticule"), now imported into this country for use in sharpening razor blades and the microtome knives used in the preparation of microscope-slide specimens. The Belgian "coticule" is a regionally metamorphosed, argillaceous sedimentary rock occurring in the Ardennes in southeastern Belgium as thin, clear yellow to yellowish gray, compact, homogeneous, fine-grained beds ½ to 3 inches thick, interstratified with blue-gray or violet Cambrian phyllites, in some places merging gradually into them but more often sharply distinct in coloring.

Billions of tiny, nearly spherical, polyhedral, hard crystals of light-yellow manganese garnet, spessartite, in a soft sericite matrix, form the principal element of the "coticule" and explain its yellow color, hardness, peculiar fitness for hones, and manganese content (17 to 22 percent MnO). The average diameter of these microscopic garnets is about 0.0008 inch. Tiny rutile and tourmaline crystals also occur in the "coticule." The mineral composition of the phyllite differs from that of the "coticule" in that hematite and carbonaceous matter are present.

The beds of coticule and attached phyllite are cut in a characteristic manner. As the phyllite has abrasive qualities part of it is left attached to the "coticule" to support it. The hones thus appear double-faced, with yellow "coticule" on one side and the softer blue-gray phyllite on the other.

Wright [12] presented the results of an extensive study to determine the varieties of garnets characteristic of different rock types. A remarkable constancy of association was shown between a given variety and a certain type of rock. His summary table of the major molecules of garnets in the rock types is reproduced here.

Average proportion of major molecules of garnets in rock types

Rock type	Spessartite	Grossularite	Pyrope	Almandite	Andradite
Pegmatite	47.1			41.8	
Granite	36.0			56.8	
Garnets associated with contact action on siliceous rocks	30.7			56.4	
Biotite schists		6.0	13.8	73.0	
Amphibole schists		20.7	20.3	53.6	
Eclogites		18.5	37.4	39.1	
Kimberlites and peridotites		9.0	72.3	13.4	
Various basic rocks		28.7	20.7	34.4	15.6
Calcareous contact rocks		51.5			40.8

The occurrence of garnets in Triassic conglomerate in York County, Pa., was described in 1938 by Stose and Glass.[13]

Miller [14] described the occurrence, character, and possible genesis of certain garnet deposits of the Adirondacks, including the Hooper, Barton, old Hooper, and Humphrey Mountain mines.

The occurrence of garnets in California was described by Sperisen [15] and Pabst.[16]

NATURAL ALUMINA ABRASIVES

Corundum.—No corundum has been mined in the United States since 1918, and regular annual production stopped in 1906. Domestic demand for crude corundum in 1938 was met by the importation of 2,098 short tons valued at $138,629, chiefly from the Union of South Africa. Both the quantity and value of imports were slightly greater than in 1937. (See fig. 4.) Virtually all corundum and emery is imported in the crude state and crushed and graded in this country for the domestic market. Imports of both corundum ore and emery ore have been curtailed sharply in depression periods.

Emery.—No sales of domestic emery were made in 1938. Production in the United States in recent years has been confined to the deposit of spinel-bearing emery near Peekskill, Westchester County, N. Y. Competition of artificial abrasives and imported emery and corundum has caused a general downward trend in the demand for domestic emery since the World War. Since 1933 sales have been

[12] Wright, W. I., The Composition and Occurrence of Garnets: Am. Mineral., vol. 23. No. 7, July 1938, pp. 436–445. (Abstract of a thesis submitted in partial fulfillment for the degree of doctor of philosophy, University of Minnesota, Minneapolis, Minn.)

[13] Stose, G. W., and Glass, J. J., Garnet Crystals in Cavities in Metamorphosed Triassic Conglomerate in York County, Pennsylvania: Am. Mineral., vol. 23, No. 7, July 1938, pp. 430–435.

[14] Miller, W. J., Genesis of Certain Adirondack Garnet Deposits: Am. Mineral., vol. 23, No. 6, June 1938, pp. 399–408.

[15] Sperisen, F. J., Gem Minerals of California: California Jour. Mines and Geol., vol. 34, No. 1, January 1938, pp. 34–78. (See pp. 60–62.)

[16] Pabst, Adolf, Minerals of California: California Dept. Natural Resources, Div. Mines Bull. 113, 1938, 344 pp. (See pp. 289–297.)

only a few hundred tons a year, and in 1938 they failed entirely. Temporary revivals in domestic sales occurred in 1928 and 1933 following curtailments in imports of emery and corundum. (See fig. 4.)

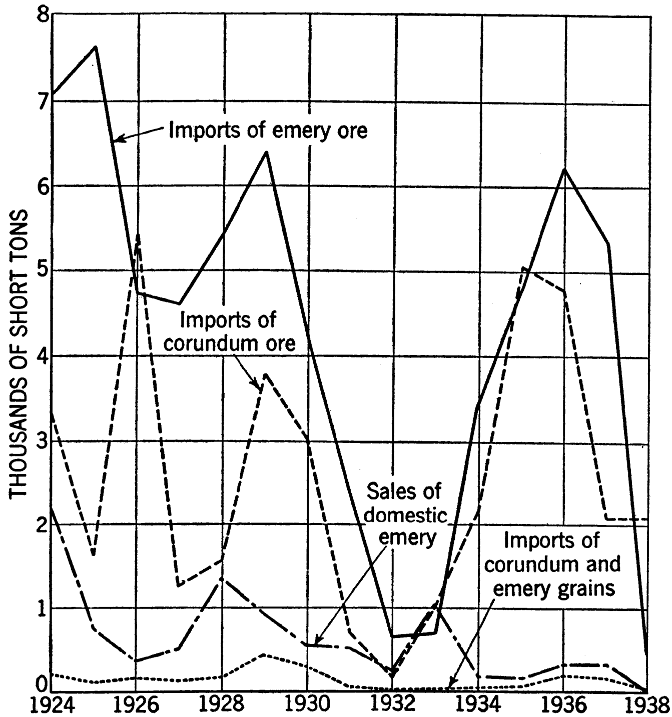

FIGURE 4.—Comparison of sales of domestic emery with imports of emery and corundum in the United States, 1924-38.

Emery sold or used by producers in the United States, 1934-38

Year	Short tons	Value	Year	Short tons	Value
1934	189	$1,800	1937	320	$2,780
1935	176	1,606	1938		
1936	325	2,900			

NATURAL CARBON ABRASIVES

Abrasive or industrial diamond.—The demand for industrial or abrasive diamond in the United States is met entirely by imports of black diamonds (carbonados) and bort. Black diamonds come chiefly from the State of Bahia (Brazil). Bort cull stones from the gem-diamond industry originate principally in the Union of South Africa. In 1938 imports of abrasive diamond into the United States were valued at $4,295,704, a decrease of nearly $2,500,000 from 1937. Declines occurred in the quantity of both bort and "glaziers' and engravers', unset, and miners' diamonds" imported. Imports of bort dropped 73 percent and those of the other classification 26 percent.

Only slight declines occurred in the average values of the two types of industrial diamond, and these probably were due largely to lowered prices resulting from the lessened demand. Bort values fell from $17.38 per carat in 1937 to $16.67 in 1938; values of the other class dropped from $3.47 per carat in 1937 to $3.02 in 1938.

There were no known developments in 1938 in the domestic diamond-bearing district near Murfreesboro, Pike County, Ark.

ARTIFICIAL ABRASIVES

The artificial-abrasive industry suffered a substantial set-back in 1938. Sales of silicon carbide, aluminum oxide, and metallic abrasives were less than in 1937, and those of the first two were even less than in 1936, reversing the upward trend in all three since 1933. The following table shows the sales of these three classes of abrasive materials for the 5-year period 1934–38.

Crude artificial abrasives sold, shipped, or used, from manufacturing plants in the United States and Canada, 1934–38 [1]

Year	Silicon carbide [2]		Aluminum oxide [2]		Metallic abrasives		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	18,038	[3] $1,753,019	46,496	[3] $3,665,226	10,312	$554,452	74,846	$5,972,697
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

[1] Bureau of Mines not at liberty to publish data for United States separately.
[2] Includes material used for refractories and other nonabrasive uses.
[3] Includes value of some grain.
[4] Production.

Production of silicon carbide centers in the Niagara Falls region in New York and that of aluminum oxide in the Niagara Falls region and at Anniston, Ala. Production of metallic abrasives is scattered through several Northern States from Michigan to New Hampshire. The following companies reported the manufacture of artificial abrasive materials in 1938.

SILICON CARBIDE:
- The Carborundum Co., Niagara Falls, N. Y.
- The Exolon Co., Blasdell, N. Y.
- General Abrasive Co., Inc., College Avenue, Niagara Falls, N. Y.
- Norton Co., 1 New Bond Street, Worcester, Mass.

ALUMINUM OXIDE:
- Abrasive Co. of Canada, Ltd., Tacony and Fraley Streets, Bridesburg, Philadelphia, Pa. (or Arvida, Canada).
- The Carborundum Co., Niagara Falls, N. Y.
- The Exolon Co., Blasdell, N. Y.
- General Abrasive Co., Inc., College Avenue, Niagara Falls, N. Y.
- Monsanto Chemical Co., 1700 South Second Street, St. Louis, Mo.
- Norton Co., 1 New Bond Street, Worcester, Mass.

METALLIC ABRASIVES:
- Alloy Metal Abrasive Co., 311 West Huron Street, Ann Arbor, Mich.
- The American Steel Abrasives Co., Galion, Ohio.
- The Globe Steel Abrasive Co., Mansfield, Ohio.
- The National Metal Abrasive Co., 3560 Norton Road, Cleveland, Ohio.
- Pittsburgh Crushed Steel Co., Alleghany Valley Railroad and Sixty-first Street, Pittsburgh, Pa.
- Steelblast Abrasives Co., Cleveland, Ohio.
- Harrison Abrasive Corporation, Manchester, N. H.

Tone[17] discussed in considerable detail the composition, hardness, crystal structure, and refractoriness of synthetic abrasive materials. Late in 1938 the National Bureau of Standards[18] issued a circular describing the manufacture of abrasive grain and abrasive products, with a bibliography of recent literature on abrasives. The production of silicon carbide, aluminum oxide, and boron carbide is described. Silicon carbide (SiC) is made in a resistance-type electric furnace, usually operated at an energy rate of 1,500 kilowatts, with a charge of approximately 60 percent silica and 40 percent low-ash petroleum coke to which are added variable quantities of ordinary wood sawdust and sodium chloride. Artificial corundum or "fused alumina" (Al_2O_3) is produced from calcined bauxite in steel-lined, water-cooled furnaces of the arc type. Coke and iron borings are added to the charge to aid in the reduction and separation of the impurities. Boron carbide (B_4C) is made in a resistance-type furnace with coke and dehydrated boric acid.

Metallic abrasives include crushed steel, steel shot, and angular steel grit. Crushed steel is made[19] from high-carbon and crucible sheet steel specially treated to impart brittleness. It is then crushed to sizes ranging from 2- to 200-mesh. After screening, each batch is heat-treated and separated into 25 sizes ranging from 20- to 200-mesh. Sizes from 70-mesh upward are screened on silk bolting cloth, and the finer sizes in powder form are used in steel cement, various chemical compounds, and fireworks sparklers.

Steel shot is merely chilled cast iron. Only raw materials of the highest grade, including selected scrap and charcoal iron, are used in its manufacture; these are melted in a cupola. During the casting period the molten metal is separated into small spherical globules by directing high-pressure steam or heated compressed air against the stream of metal. The globules are blown into water and cooled. The shot, made brittle by the rapid cooling, is heat-treated to impart a temper of hardness and graded by mechanical means into 15 sizes that range from 4- to 90-mesh. Coarse material left on the 4-mesh screen is granulated by specially designed crushing equipment and in this form is known as angular steel grit. The crushed material is heat-treated to impart toughness and durability, then graded into 15 sizes ranging from 7- to 100-mesh. Steel shot and angular steel grit are used for many abrasive purposes.

MISCELLANEOUS ABRASIVE MATERIALS

Besides the materials already discussed several others are used for abrasive purposes. Several oxides—tin oxide, rouge and crocus (forms of ferric oxide), chromium oxide, magnesium oxide, manganese oxide, and lime—as well as clay, talc, and whiting, are used as polishing agents. Silt, clay, feldspar, and other substances sometimes are used as abrasives.

FOREIGN TRADE[20]

The decline of nearly 3 million dollars in the total value of abrasive materials imported for consumption in the United States in 1938 from

[17] Tone, F. J., The Quest for Hard Materials: Ind. and Eng. Chem. (Ind. Ed.), vol. 30, No. 2, February 1938, pp. 232-242.
[18] National Bureau of Standards, Artificial Abrasives and Abrasive Products: Letter Circ. LC-540, Dec. 21, 1938, 8 pp.
[19] Abrasives, Metallic Abrasive Data Are Requested: Vol. 19, No. 6, June 1938, pp. 44, 46.
[20] 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 of 1937 was due principally to the decrease of nearly half a million carats in imports of glaziers' and engravers' (unset) and miners' diamonds. Imports of these types of diamonds, which constitute the greater part of the total value of all imported abrasives, declined from 1,885,970 carats valued at $6,542,365 in 1937 to 1,396,247 carats valued at $4,213,412 in 1938. Declines were registered also in imports of most other types of abrasives, but imports of garnets, rough or unmanufactured millstones, hones, oilstones, and whetstones, and corundum ore increased. Garnets were imported for the first time in several years. The declines in imports of corundum (and emery) grains, diamond dust, bort, and emery ore were especially marked.

The total value of exports of all recorded classes of natural abrasives in 1938 was less than in 1937, the decline in the values of grindstones and abrasive wheels (emery and corundum) being much greater than the increase in the value of the much larger remaining class, which includes all other natural abrasives.

Abrasive materials imported for consumption in the United States, 1936–38, by kinds

Kind	1936		1937		1938	
	Quantity	Value	Quantity	Value	Quantity	Value
Millstones and burrstones:						
Rough or unmanufactured short tons					11	$894
Bound up into millstones do	25	$2,228	29	$2,896	15	1,318
Grindstones, finished or unfinished do	815	24,638	963	32,445	657	22,431
Hones, oilstones, and whetstones do	87	41,252	69	43,470	101	44,142
Emery:						
Ore do	6,217	77,548	5,357	87,557	477	7,796
Grains, ground, pulverized, or refined pounds	(1)	(1)	(1)	(1)	(1)	(1)
Paper and cloth of emery or corundum	(2)	18,215	(2)	31,937	(2)	21,137
Wheels, files, and other manufactures of emery or corundum or garnet pounds	136,966	78,677	123,106	72,925	79,901	49,146
Corundum (see also "Emery"):						
Ore short tons	4,790	290,221	2,085	134,574	2,098	138,629
Grains, ground, pulverized, or refined pounds	[1] 390,111	[1] 30,125	[1] 329,121	[1] 29,445	[1] 65,608	[1] 6,155
Garnet in grains, or ground, pulverized, etc. pounds					3,696	193
Tripoli and rottenstone short tons	522	11,759	871	12,207	498	9,826
Pumice:						
Crude or unmanufactured do	7,041	54,580	8,771	57,563	5,943	34,486
Manufactures of, or of which pumice is the component material of chief value	(3)	29,931	(3)	34,855	(3)	20,809
Diamond:						
Bort carats	3,779	79,679	4,203	73,069	1,151	19,187
Dust	(3)	2,537	(3)	145,036	(3)	63,105
Glaziers' and engravers', unset, and miners' carats	1,166,094	4,328,603	1,885,970	6,542,365	1,396,247	4,213,412
Flint, flints, and flint stones, unground short tons	9,910	90,531	13,428	117,828	8,169	74,338
		5,160,524		7,418,172		4,727,004

[1] Emery included with corundum; not separately classified.
[2] 2,494 reams in 1936; 3,276 reams in 1937; 1,924 reams in 1938; weight not recorded.
[3] Quantity not recorded.

Value of domestic abrasive materials exported from the United States, 1934–38

Material	1934	1935	1936	1937	1938
Grindstones	$143,626	$148,943	$140,614	$193,112	$122,720
Abrasive wheels, emery and corundum	113,118	116,376	124,471	140,022	116,456
All other natural abrasives, hones, whetstones, etc.	254,515	250,228	277,463	826,955	835,894

SULFUR AND PYRITES

By Robert H. Ridgway and A. W. Mitchell

SUMMARY OUTLINE

Demand for sulfur was lower in 1938 than in 1937, and world production declined because of a smaller output in the United States. Production in Italy, the second largest source, increased moderately. Data for Japan, normally the third largest producer, are not available. Exports from the principal sources of supply decreased, owing not only to lower rate of consumption but also to increased recovery in some market areas of elemental sulfur as a byproduct in industrial processes. Germany, formerly a large market for native sulfur, has now developed a supply of elemental sulfur from byproduct sources adequate for its own increasing needs. Spain, Japan, and Norway were the largest producers of pyrites in 1938, but operations in Spain, the largest source, were hampered by the civil war.

Consumption of both sulfur and pyrites in the United States decreased in 1938. Probably the most significant event of 1938 in the domestic industry was the reduction in the quotations on sulfur at the beginning of the last quarter—the first change in the quotations since 1926. Maintenance of the price at $18 per long ton throughout the good years as well as the depression has made the market attractive and has resulted in technical investigations into sulfur production, as well as research for substitutes and substitute processes which have been somewhat successful. Apparently pressure resulting from increased production of byproduct sulfur and additional domestic production of native sulfur affected the change in sulfur quotations. While domestic production dropped in 1938 shipments recorded an even greater decline, resulting in record stocks at the mines.

[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 1935–38

	1925–29 (Average)	1935	1936	1937	1938
Sulfur:					
Production of crude sulfur..long tons..	1,951,034	1,632,590	2,016,338	2,741,970	2,393,408
Shipments of crude sulfur:					
For domestic consumption..do....	1,397,411	1,232,607	1,421,621	1,791,215	1,052,890
For export..........do....	707,175	402,383	547,199	675,297	575,957
Total shipments..........do....	2,104,586	1,634,990	1,968,820	2,466,512	1,628,847
Imports..........do....	1,896	1,763	530	398	51
Exports of treated sulfur..........do....	11,956	10,916	19,708	13,533	12,707
Producers' stocks at end of year.do....	2,413,000	3,100,000	3,100,000	3,400,000	4,200,000
Price of crude sulfur f. o. b. mines, per long ton..........	$17.50	$18	$18	$18	$16–$18
Pyrites:					
Production..........long tons..	273,936	514,192	547,236	584,166	555,629
Imports..........do....	372,958	397,113	429,313	524,430	334,234
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	603,627	732,620	833,994	(1)

[1] Figures not yet available.

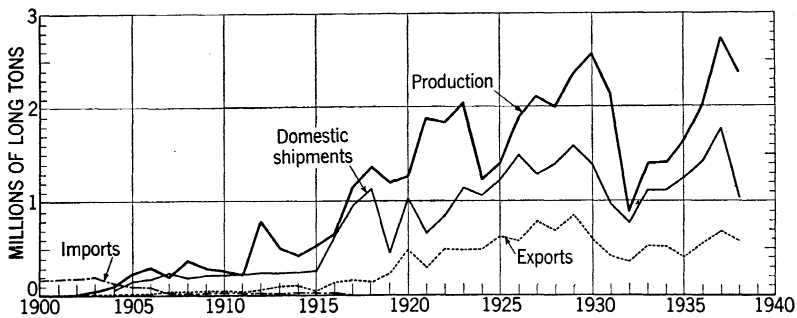

FIGURE 1.—Domestic production, domestic shipments, exports, and imports of crude sulfur, 1900–1938.

The production of native sulfur in the United States up to and including 1938 has totaled more than 43 million long tons. Virtually the entire output has been made since 1900. The principal trends in the sulfur and pyrites industries are shown in figures 1 and 2.

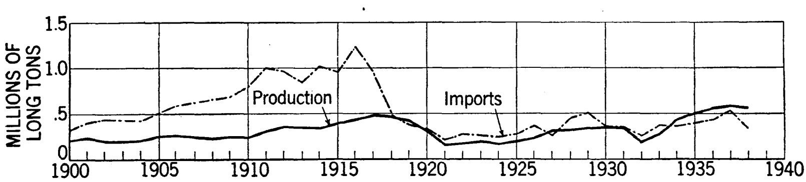

FIGURE 2.—Domestic production and imports of pyrites, 1900–1938.

SULFUR

Domestic production.—Production of sulfur in the United States in 1938 decreased 13 percent from the record total in 1937. Curtailment of shipments from domestic mines, however, was more severe, comprising 34 percent of the record figure in 1937. Several hundred tons of sulfur-bearing ore used for agricultural purposes are not included in the total for 1937. None of this material was reported in 1938.

Sulfur produced and shipped in the United States, 1934–38

Year	Produced (long tons)	Shipped		Year	Produced (long tons)	Shipped	
		Long tons	Approximate value			Long tons	Approximate value
1934	1,421,473	1,613,838	$28,900,000	1937	2,741,970	2,466,512	$44,300,000
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				

Eighty-six percent of the domestic output of sulfur reported for 1938 came from Texas and the bulk of the remainder from Louisiana. California and Utah produced only 4,158 long tons. Thus, the first two States produced more than 99 percent of the domestic output. Active mines in 1938 are listed in the following table.

Mines that produced sulfur in the United States in 1938

Operating company	Name of mine	Location of mine
California:		
Nevada Pacific Sulphur Co	Gup No. 1	Oasis, Inyo County.
Western Mining Corporation	Crater	Bigpine, Inyo County.
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.
Do	Long Point Dome	Needville, Fort Bend County.
Utah: Utah Sulphur Industries	Utah Sulphur Industries.	Beaver, Beaver County.

Byproduct sulfur.—A small quantity of byproduct sulfur is produced annually incident to the purification of manufactured fuel gases. In 1938, 3,674 long tons were produced from this source, of which 2,507 tons were shipped; the rest is stored or accumulated in dumps at various plants. Several processes are used. The largest quantity is recovered by the Thylox process,[2] although a considerable quantity is recovered by the Ferrox process. The product is shipped either as 99 percent or more pure sulfur or as a sludge or paste containing 33 to 50 percent sulfur. The output is not included in the sulfur-production figures of the United States.

The conversion of waste material, which may be somewhat of a nuisance, into a marketable product is the object of a study conducted by the Bureau of Mines, designed to recover sulfur from smelter smoke.[3]

Stocks.—As production exceeded shipments in 1938, stocks at the mines increased during the year and on December 31 amounted to 4,200,000 long tons.

Price.—The price of sulfur was reduced in 1938—the first change in the quotations since 1926. The price at the mines dropped from

[2] Foxwell, G. E., and Grounds, A., Thylox Process for the Recovery of Sulfur from Gases Containing Hydrogen Sulfide: Chem. and Ind., vol. 58, No. 8, Feb. 25, 1939, pp. 163–170.
[3] Roberson, A. H., and Marks, G. W., Fixation of Sulfur from Smelter Smoke: Progress Reports—Metallurgical Division, No. 26: Bureau of Mines Rept. of Investigations 3415, 1938, pp. 1–45.

$18 to $16 per long ton at the beginning of the last quarter, while the ex-vessel quotation along the Atlantic seaboard was reduced from $22 to $20.50 at all ports except Boston, Mass., and Portland, Maine. where the price was $22.50.

Byproduct sulfuric acid.—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 smelting copper and zinc concentrates the 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 3 years ended in 1937. 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. The figures for 1934 to 1937, inclusive, do not include the acid made from the pyrites concentrate in Tennessee but do include the relatively small amount of acid made from pyrites concentrate in Wisconsin. For 1933 pyrites acid from both States is included.

Byproduct sulfuric acid (expressed as 60° B.) produced at copper and zinc plants in the United States, 1933–37, in short tons [1]

	1933	1934	1935	1936	1937
Copper plants	[2] 301,075	168,676	160,151	226,738	[3] 291,638
Zinc plants	355,027	406,984	443,476	505,882	542,356
	[2] 656,102	575,660	603,627	732,620	[3] 833,994

[1] Figures for 1938 not yet available.
[2] Includes acid made from pyrites concentrates in Tennessee.
[3] Includes a small amount of sulfuric acid produced as a byproduct in the roasting of high-sulfide gold and silver concentrates.

Processes recently have been developed for the recovery of sulfuric acid in the treatment of natural gases and refinery gases to remove hydrogen sulfide, and plants utilizing these processes are now operating. Acid from this source is not included in the byproduct acid figures in the preceding table.

Consumption.—The apparent domestic consumption of sulfur in 1938 dropped 41 percent below the record level in 1937.

Apparent consumption of sulfur in the United States, 1934–38, in long tons

	1934	1935	1936	1937	1938
Shipments	1,613,838	1,634,990	1,968,820	2,466,512	1,628,847
Imports	5,839	1,763	530	398	51
	1,619,677	1,636,753	1,969,350	2,466,910	1,628,898
Exports:					
Crude	507,115	402,383	547,199	675,297	575,957
Refined	10,112	10,916	19,708	13,533	12,707
	517,227	413,299	566,907	688,830	588,664
Apparent consumption	1,102,450	1,223,454	1,402,443	1,778,080	1,040,234

The consumption of sulfur in various industries from 1934 through 1938 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfur consumed in the United States, 1934–38, by uses, in long tons [1]

Use	1934	1935	1936	1937	1938
Chemicals	512,000	555,000	620,000	777,000	484,000
Fertilizer and insecticides	247,000	239,000	266,000	415,000	220,000
Pulp and paper	176,000	204,000	260,000	302,000	174,000
Explosives	43,000	42,000	53,000	68,000	50,000
Dyes and coal-tar products	34,000	39,000	46,000	49,000	40,000
Rubber	30,000	33,000	39,000	37,000	29,000
Paint and varnish	4,000	48,000	54,000	64,000	50,000
Food products	4,000	4,000	4,500	6,000	5,500
Miscellaneous	60,000	68,500	78,000	82,000	47,500
	1,110,000	1,232,500	1,420,500	1,800,000	1,100,000

[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, declined in 1938, reflecting the decreased consumption of chemicals. Consumption of acid in the domestic fertilizer industry, the largest outlet, dropped owing to the reduction in production of superphosphate. The T. V. A. continued its researches into the manufacture of phosphate fertilizers and announced successful operation of a small commercial-sized unit for the manufacture of calcium metaphosphate, a highly concentrated material containing 28 percent phosphorus, which uses phosphorus produced by electric furnaces.[4] Activities in the petroleum-refining industry, the second largest consumer of sulfuric acid, held up rather well, resulting in a relatively small decline in acid consumption. This industry, however, is also a potential source of acid, and several plants are producing acid as a byproduct in the treatment of refinery and natural gases.

The consumption of sulfuric acid, by industries, from 1934 through 1938 has been estimated by Chemical and Metallurgical Engineering as follows:

Sulfuric acid (expressed as 50° B.) consumed in the United States, 1934–38, by industries, in short tons

Industry	1934	1935	1936	1937	1938
Fertilizer	1,650,000	1,720,000	1,987,000	2,510,000	2,100,000
Petroleum refining	1,100,000	980,000	1,100,000	1,210,000	1,120,000
Chemicals	910,000	940,000	955,000	1,020,000	790,000
Coal products	500,000	625,000	770,000	860,000	585,000
Iron and steel	475,000	630,000	770,000	850,000	500,000
Other metallurgical	400,000	520,000	560,000	620,000	350,000
Paints and pigments	330,000	400,000	450,000	525,000	430,000
Explosives	180,000	175,000	222,000	230,000	185,000
Rayon and cellulose film	256,000	303,000	330,000	380,000	310,000
Textiles	75,000	90,000	108,000	112,000	90,000
Miscellaneous	290,000	342,000	380,000	400,000	300,000
	6,166,000	6,725,000	7,632,000	8,717,000	6,760,000

[4] Tennessee Valley Authority, Annual Report for the Fiscal Year Ended June 30, 1938: Washington, D. C., 1938, p. 32.

The leading domestic producers have carried on research work with a view to broadening the market for sulfur, but to date no large-tonnage outlet has been developed. New applications for sulfur have been discussed by Duecker.[5]

Foreign trade.—Exports of sulfur in 1938 dropped 15 percent from the 1937 figure but were larger than in any other year since 1930; data by years from 1934 to 1938, inclusive, follow.

Sulfur imported into and exported from the United States, 1934–38

Year	Imports		Exports			
	Ore		Crude		Crushed, ground, refined, sublimed, and flowers of	
	Long tons	Value	Long tons	Value	Long tons	Value
1934	5,839	$76,631	507,115	$9,364,501	10,112	$398,043
1935	1,763	26,164	402,383	7,582,293	10,916	418,532
1936	530	10,141	547,199	10,147,038	19,708	746,985
1937	398	4,724	675,297	12,155,253	13,533	509,133
1938	51	562	575,957	10,332,529	12,707	469,773

Shipments of crude sulfur to Canada, formerly the largest market, fell abruptly in 1938 and amounted to only 43 percent of the 1937 figure. Australia increased its takings 52 percent over 1937 and became the largest customer. Canada, however, continued as the largest market for treated sulfur. The following table shows the distribution of exports by countries of destination for 1937 and 1938.

Sulfur exported from the United States, 1937–38, by countries

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1937		1938		1937		1938	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
North America:								
Canada	193,947	$3,527,480	82,651	$1,486,463	6,537,308	$130,188	5,236,975	$107,157
Central America	125	4,037	118	3,632	329,763	8,269	282,469	7,083
Mexico	9,394	193,181	5,946	124,435	1,813,162	34,329	1,556,482	32,216
Newfoundland and Labrador	8,519	157,073	2,989	53,802	2,800	71	4,000	163
West Indies	9,897	191,638	8,575	160,837	931,842	23,083	211,715	5,290
	221,882	4,073,409	100,279	1,829,169	9,614,875	195,940	7,291,641	151,909
South America:								
Argentina	8,450	152,100	16,102	288,969	15,386	2,238	81,529	2,777
Brazil	70	1,792	4,106	82,715	477,744	7,666	359,867	6,805
Colombia	(1)	28			404,129	10,584	443,427	12,041
Uruguay	1,000	18,000						
Other South America					219,435	3,906	242,905	4,118
	9,520	171,920	20,208	371,684	1,116,694	24,394	1,127,728	25,741
Europe:								
Belgium	1,004	19,578	6,032	113,387	158,864	2,380	101,798	1,390
Denmark					1,132,449	14,146	1,361,579	17,090
France	107,111	1,937,343	98,751	1,826,896	739,979	10,150	522,049	6,807
Germany	47,349	874,721	32,817	610,750	1,578,797	21,179	454,148	5,919

[1] Less than 1 ton.

[5] Duecker, W. W., New Applications of Sulfur: Min. and Met., vol. 19, No. 383, November 1938, pp. 473–476.

Sulfur exported from the United States, 1937–38, by countries—Continued

Country	Crude				Crushed, ground, refined, sublimed, and flowers of			
	1937		1938		1937		1938	
	Long tons	Value	Long tons	Value	Pounds	Value	Pounds	Value
Europe—Continued.								
N2therlands	20,714	$386,357	21,663	$418,980	625,004	$7,697	1,009,701	$12,672
Sweden	4,883	87,894	5,993	106,199	467,149	5,641	676,783	8,499
United Kingdom	104,067	1,823,869	95,985	1,568,570	5,496,937	70,312	4,935,464	65,730
Other Europe	12,657	227,826	8,400	149,800	1,855,031	25,489	2,089,286	27,439
	297,785	5,357,588	269,641	4,794,582	12,054,210	156,994	11,150,808	145,546
Asia	13,006	228,252	8,832	180,468	1,988,854	34,550	2,986,877	46,917
Africa:								
Algeria	10,502	174,387	14,057	261,903				
Mozambique					497,337	9,627	359,267	6,444
Union of South Africa	16,612	291,373	11,298	203,364	1,524,929	27,456	1,250,551	24,803
Other Africa			10	250	60,588	1,175	189,595	2,942
	27,114	465,760	25,365	465,517	2,082,854	38,258	1,799,413	34,189
Oceania:								
Australia	71,334	1,241,116	108,465	1,928,755	3,194,885	50,828	3,805,520	56,529
New Zealand	34,656	617,208	43,167	762,354	260,597	8,154	299,768	8,924
Other Oceania					1,409	15	1,200	18
	105,990	1,858,324	151,632	2,691,109	3,456,891	58,997	4,106,488	65,471
	675,297	12,155,253	575,957	10,332,529	30,314,378	509,133	28,462,955	469,773

THE INDUSTRY IN 1938, BY STATES

California.—Two operators in California reported production in 1938, but by far the larger output came from the Crater Group mine, Inyo County operated by the Western Mining Corporation.

Louisiana.—Production of sulfur in Louisiana in 1938 totaled 328,405 long tons and was made by the Freeport Sulphur Co. from its operations at Grand Ecaille, Plaquemines Parish, where further plant improvements were under way during the year.

An amendment to the Louisiana Constitution adopted November 8, 1938, provided that the State Severance Tax shall not exceed $1.03 per long ton, effective as of July 27, 1938. The previous tax was $2 per ton. The amendment also provides for an ad-valorem tax on unmined sulfur previously exempt.

Texas.—Texas supplied 86 percent of the domestic output in 1938. Six operations contributed to the total, but 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 1938.

Sulfur produced in Texas in 1938, by companies, in long tons

Company	First quarter	Second quarter	Third quarter	Fourth quarter	Total
Texas Gulf Sulphur Co	399,626	318,210	268,882	235,902	1,222,620
Freeport Sulphur Co	91,160	91,095	88,915	84,615	355,785
Jefferson Lake Oil Co., Inc	58,825	56,803	52,319	100,182	268,129
Duval Texas Sulphur Co	35,461	56,000	62,870	58,075	212,406
	585,072	522,108	472,986	478,774	2,058,940

The Texas Gulf Sulphur Co. also produced at Long Point Dome where operations were suspended during 1938 owing to exhaustion of sulfur on the tract then operated. 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., increased substantially in 1938 when additional capacity was installed. In addition to its output on certain tracts on Boling Dome, the Duval Texas Sulphur Co. inaugurated production at Orchard Dome, Fort Bend County, in 1938.

Utah.—Sulfur production in Utah in 1938 came from the Utah Sulphur Industries plant at Beaver, Beaver County.

WORLD PRODUCTION

World production of sulfur in 1938, including elemental sulfur recovered in the treatment of pyrites and as a byproduct from the manufacture of gas and gasoline in Germany, is estimated at 3,200,000 long tons. The following table shows the output of native sulfur for the world from 1934 through 1938.

World production of native sulfur, 1934–38, in long tons [1]

[Compiled by R. B. Miller]

Country	1934	1935	1936	1937	1938
Argentina	------------	7	------------	(2)	(2)
Bolivia (exports)	5,620	4,183	935	1,712	1,632
Chile	20,356	[3] 19,792	[3] 25,525	[3] 22,345	(2)
China	4,393	(2)	(2)	(2)	(2)
Ecuador	91	118	59	54	68
France (content of ore)	69	64	123	157	(2)
Greece	105	23	150	67	(2)
Guatemala	------------	------------	16	11	(4)
Italy (crude) [5]	337,966	307,024	322,396	338,101	370,913
Japan [6]	133,273	162,341	172,545	(2)	(2)
Mexico	846	[7] 3,206	[7] 1,272	(2)	49
Netherland East India	12,047	9,492	11,311	12,474	(2)
Palestine	------------	561	79	494	1,196
Peru	1,455	2,117	1,696	1,551	2,813
Spain (refined) [8]	31,130	(2)	(2)	(2)	(2)
Taiwan	1,062	1,054	1,207	(2)	(2)
Turkey	86	1,072	3,081	2,694	(2)
United States	1,421,473	1,632,590	2,016,338	2,741,970	2,393,408

[1] Sulfur is also believed to be produced in the U. S. S. R., but the amount of its production 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] Less than 1 ton.
[5] In addition, the following quantities of sulfur rock are reported: 1934, 21,820 tons; 1935, 18,738 tons; 1936, 20,743 tons; and 1937, 19,793 tons.
[6] In addition, the following quantities of sulfur rock are reported: 1934, 4,706 tons; 1935, 20,764 tons; and 1936, 31,576 tons. Similar data are not available for 1937–38.
[7] Crude sulfur product.
[8] Refined sulfur, exclusive of that made from imported crude sulfur.

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 first commercial unit went into production in 1936,[6] and 12,083 long tons were produced in 1937. Data on output in 1938 are not available, but a 50-ton-per-day unit was added to the plant capacity. The Aldermac Mines, Ltd., is planning to recover sulfur by the Comstock-Westcott process from the cupriferous

[6] Kirkpatrick, S. D., Trail Solves Its Sulfur Problem: Chem. and Met. Eng., vol. 45, No. 9, September 1938, pp. 483–485.

pyrite output of the Aldermac mine near Rouyn, Beauchastel Township, Quebec. Imports of sulfur into Canada dropped sharply in 1938, amounting to only 83,658 long tons compared with 201,504 tons in 1937.

Chile.—The Chilean Government is interested in promoting the production of sulfur both directly and through such semiofficial institutions as the Miners Credit Bank. Data on production for 1938 are not yet available, but the total may reach 20,000 long tons. Exports, however, were much lower than in 1937, amounting to only 3,794 tons for the first 11 months compared with 19,378 tons for the same period in 1937.

Germany.—Germany produces no native sulfur, and in the past its requirements have been met by imports, largely from the United States; imports in 1938 were 101,958 long tons, of which 65 percent came from Italy. Much of the sulfur imported into Germany is transshipped to nearby countries; exports in 1938 were 22,876 tons. In recent years the production of byproduct sulfur has been making rapid progress, and by 1940 Germany may be self-sufficient. It is believed that output of elemental sulfur in 1938 from all sources, notably from coking plants, low-temperature carbonization plants, and gasoline hydrogenation plants, may have reached 70,000 tons or nearly two-thirds of requirements. Formerly nearly the entire German output of elemental sulfur came from desulfurization at coke plants, but most of the gain in production recently has been the result of installation of improved recovery methods at gasoline hydrogenation plants, now the main source of supply.

Iceland.—A plant for the production of sulfur at Myvatan was under construction late in 1938. Plans call for an output of 4,000 long tons a year from deposits in northern Iceland.

Italy.—Italy, including Sicily, is the world's second-largest producer of sulfur. Production in 1938 was 370,913 long tons compared with 338,101 tons in 1937. Exports of crude and refined sulfur from Italy dropped sharply from 384,067 tons in 1937 to 223,804 tons in 1938.

Japan.—Data on the production of sulfur in Japan in 1938 are not available; exports were 31,012 long tons compared with 54,961 tons in 1937.

Norway.—Production of sulfur in Norway results from the treatment of cupriferous pyrites at the Thamshavn plant of the Orkla Metal Co. Output was at a lower level in 1938 than in 1937. Exports in 1938 were 75,420 long tons compared with 95,695 tons in 1937. Although Norway has been an exporter of sulfur since 1932, it continues to import sulfur; imports in 1938 were 6,553 tons.

Portugal.—Production of elemental sulfur from pyrites at the San Domingos mine in the Province of Alemtejo was begun in 1935. Output in 1938 was 11,059 long tons compared with 13,021 tons in 1937; imports in 1938 were 3,408 tons compared with 2,336 tons in 1937.

Spain.—The output of native sulfur in Spain is augmented 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.[7] at Ronskar in North Sweden is the only sulfur produced in Sweden. Output at this plant was 17,512 long

[7] Palen, A. G. Paul, Boliden Improves Work at Ronskar Smelter: Eng. and Min. Jour., vol. 139, No. 9, September 1938, pp. 54-55.

tons in 1938 compared with 18,141 tons in 1937. Imports of sulfur in 1938 were 47,309 tons compared with 83,009 tons in 1937.

PYRITES

Domestic production.—Production of pyrites (ores and concentrates) in the United States in 1938 dropped 5 percent from the record figures in 1937 but was greater than in any other year. Of the 1938 total, 101,701 long tons were lump, and the rest was fines; most of the fines were flotation concentrates.

Pyrites (ores and concentrates) produced in the United States, 1934–38

Year	Quantity		Value	Year	Quantity		Value
	Gross weight (long tons)	Sulfur content (percent)			Gross weight (long tons)	Sulfur content (percent)	
1934	432,524	38.8	$1,216,363	1937	584,166	39.7	$1,777,787
1935	514,192	39.5	1,583,074	1938	555,629	39.4	1,685,766
1936	547,236	39.6	1,666,194				

The quantity of pyrites (ores and concentrates) sold or consumed by producing companies totaled 524,120 long tons in 1938 compared with 568,470 tons in 1937. In 1938, 163,711 tons were sold by producers compared with 181,322 tons in 1937. All sales in both years were to domestic consumers. Prices quoted by trade journals are for imported pyrites and are given in cents per long-ton unit, 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 1938; other States producing were California, Colorado, Illinois, Kansas, Missouri, Montana, New York, Virginia, and Wisconsin.

THE INDUSTRY IN 1938, BY STATES

California.—The Mountain Copper Co. was the only producer of pyrites in California in 1938; output came from the Hornet mine in Shasta County.

Colorado.—One operator shipped pyrites concentrates in Colorado in 1938. No pyrites was shipped from the mill-tailings dump of the Colorado zinc-lead mill in Lake County during the year.

Illinois.—In 1938 two coal operators in Illinois, the Peabody Coal Co. in Christian County and the Midland Electric Coal Corporation in Henry County, produced and shipped pyrites (coal brasses) recovered as a byproduct in coal-cleaning operations. The pyrites was used in the manufacture of sulfuric acid.

Kansas.—The Mineral Products Co. produced 17,757 long tons of pyrites (coal brasses) in 1938 at West Mineral, Cherokee County. Shipments, which averaged 47 percent sulfur, were consigned to St. Louis, Mo., where they were used in acid making.

Missouri.—Two operators produced and shipped 28,828 long tons of pyrites—the total output of Missouri in 1938. Shipments averaged

48.8 percent sulfur and moved to acid plants in the St. Louis area. The largest producer was the Moselle No. 10 mine in Phelps County, operated by Thomas and Williams. Other production came from the Judith Spring mine in Franklin County, operated by Julian Pickles.

Montana.—The pyrites produced in Montana in 1938 came from the Anaconda Copper Mining Co. at Anaconda, where it is recovered as a flotation concentrate in copper-plant operation.

New York.—During 1938 the St. Joseph Lead Co. produced 63,772 long tons of pyrites concentrate at its Balmat Mill in St. Lawrence County. The pyrites, which ran 49.72 percent sulfur, was produced as a flotation concentrate in the treatment of ore in which zinc is the principal value.

Tennessee.—The pyrites produced in Tennessee in 1938 came from the operations of the Tennessee Copper Co. in the Ducktown Basin, Polk County. It is produced as a flotation concentrate but does not enter the market, as the entire output is used by the company in the manufacture of sulfuric acid.

Virginia.—The only pyrites mined in Virginia in 1938 came from the Gossan mine at Cliffview, Carroll County, operated by the General Chemical Co., where a new mill was put into operation late in the year. The ore is mined by underground methods, and before the new mill was in operation lump ore was shipped. The entire output is used for the manufacture of sulfuric acid in the company plant at Pulaski.

Wisconsin.—The only company reporting pyrites production in Wisconsin in 1938 was the Vinegar Hill Zinc Co. in Grant County, which makes a pyrites concentrate in its magnetic separation plant at Cuba City from ore from several mines in the Platteville district.

FOREIGN TRADE

Imports of pyrites in 1938 fell off 36 percent from the 1937 figure. Despite the civil war, Spain continued to supply the bulk of our imports; much smaller amounts came from Canada and Mexico. No pyrites has been exported since 1931.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1934–38, by countries

Country	1934		1935		1936		1937		1938	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Belgium	------	--------	------	--------	5,290	$29,756	------	--------	------	--------
Canada	19,341	$83,086	9,888	$45,965	55,105	200,184	20,558	$74,946	30,064	$135,659
Mexico	------	--------	85	430	------	--------	549	1,473	202	522
Portugal	------	--------	------	--------	59,804	286,974	21,725	109,395	------	--------
Spain	346,974	1,162,574	387,140	1,266,606	309,114	913,820	481,598	1,158,671	303,968	709,983
	366,315	1,245,660	397,113	1,313,001	429,313	1,430,734	524,430	1,344,485	334,234	846,164

The bulk of the imports of pyrites moves into Philadelphia and Maryland, where it is used in the manufacture of sulfuric acid.

Pyrites, containing more than 25 percent sulfur, imported into the United States, 1934–38, by customs districts, in long tons

Customs district	1934	1935	1936	1937	1938
Buffalo	44	94	140	584	5,130
Chicago		2,704			
Georgia	3,530	4,002	2,500	4,795	
Los Angeles		848			
Maryland	162,183	182,333	172,290	220,430	113,838
New York	46,358	56,725	60,041	64,621	55,830
Ohio	12,668				
Philadelphia	116,361	129,793	158,088	194,680	130,703
San Diego		85		549	202
South Carolina	11,541	7,681	9,429	9,519	5,265
Vermont	6,629	6,242	17,449	19,974	15,713
Virginia	7,001	6,606	9,376	9,278	7,553
	366,315	397,113	429,313	524,430	334,234

WORLD PRODUCTION

The following table shows world production of pyrites and its sulfur content. Most of the figures are taken 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), 1936–38, in metric tons

[Compiled by M. T. Latus]

Country [1]	1936		1937		1938	
	Gross weight	Sulfur content	Gross weight	Sulfur content	Gross weight	Sulfur content
Algeria	19,965	9,184	38,760	17,830	44,750	20,585
Australia (Tasmania)	34,252	(2)	41,282	(2)	(2)	(2)
Canada	115,404	57,305	108,370	54,595	40,464	20,300
Chosen	78,036	(2)	79,500	(2)	(2)	(2)
Cyprus [3]	223,904	111,952	395,076	193,587	(2)	(2)
Czechoslovakia	19,084	8,017	18,361	7,712	(2)	(2)
Finland	78,720	34,401	91,311	39,264	(2)	(2)
France	148,025	66,043	145,820	65,027	147,208	65,655
Germany	302,298	122,219	447,345	193,050	(2)	(2)
Greece	208,050	101,031	206,650	100,295	(2)	(2)
Italy	865,404	372,124	914,524	402,391	918,000	(2)
Japan	1,750,914	700,366	(2)	(2)	(2)	(2)
Norway	1,031,825	456,156	1,048,300	452,709	1,010,000	(2)
Poland	38,110	16,768	82,263	36,195	92,209	36,883
Portugal	237,728	112,921	604,132	283,986	(2)	(2)
Rumania	9,999	5,000	10,717	6,717	(2)	(2)
Southern Rhodesia	19,447	7,824	20,342	8,128	27,065	(2)
Sweden	134,206	57,014	172,968	75,337	(2)	(2)
Union of South Africa	24,533	11,154	28,915	12,931	31,017	(2)
United Kingdom	4,697	(2)	4,701	(2)	(2)	(2)
United States	556,019	220,068	593,542	235,520	564,547	222,612
Uruguay					70	(2)
Yugoslavia	79,754	35,889	133,985	60,253	150,402	67,681

[1] In addition to countries listed Belgium, China, Spain, and the U. S. S. R. produce pyrites, but production data are not available.
[2] Data not available.
[3] Exports.

Canada.—Of the Canadian pyrites output in 1938, 30,099 metric tons containing 15,041 tons of sulfur came from Quebec and 10,365 tons containing 5,259 tons of sulfur from British Columbia. Most of the shipments from Quebec came from the Eustis mine of the Consolidated Copper & Sulphur Co. near Sherbrooke. The Aldermac Copper Corporation, operator of the Aldermac mine in Beauchastel Township, made some shipments, but the bulk of its output of pyrites concentrates was stored awaiting the construction of a plant to manufacture elemental sulfur from pyrite. 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.

In addition, sulfuric acid is made from smelter gases at the Trail and Copper Cliff smelters, and elemental sulfur is made at Trail. In 1938, 81,663 metric tons of sulfur were recovered as sulfur or as sulfuric acid manufactured from smelter gases.

Japan.—Japan is one of the large producers of pyrites, but data on production in 1937 and 1938 are not available, owing to a ban on information pertaining to domestic production and consumption of pyrites. The entire output is consumed locally in the manufacture of sulfuric acid, and Japan is said to be self-sufficient as regards pyrites.

Norway.—Production of pyrites is the principal mining industry in Norway, and output exceeded 1,000,000 metric tons in 1938 for the third successive year. Exports were slightly lower in 1938, amounting to 654,955 tons compared with 676,535 tons in 1937. Some of the Norwegian pyrites is used locally for the production of elemental sulfur.

Portugal.—Production in Portugal was high in 1937 and 1938. Exports were 456,786 metric tons in 1938 compared with 652,750 tons in 1937.

Spain.—Spain is the principal world producer of pyrites, but war conditions undoubtedly affected operations during 1938. Data for recent years are not available.

PHOSPHATE ROCK

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Export and domestic demand for American phosphate rock appears to have become stabilized. For the third time in three decades

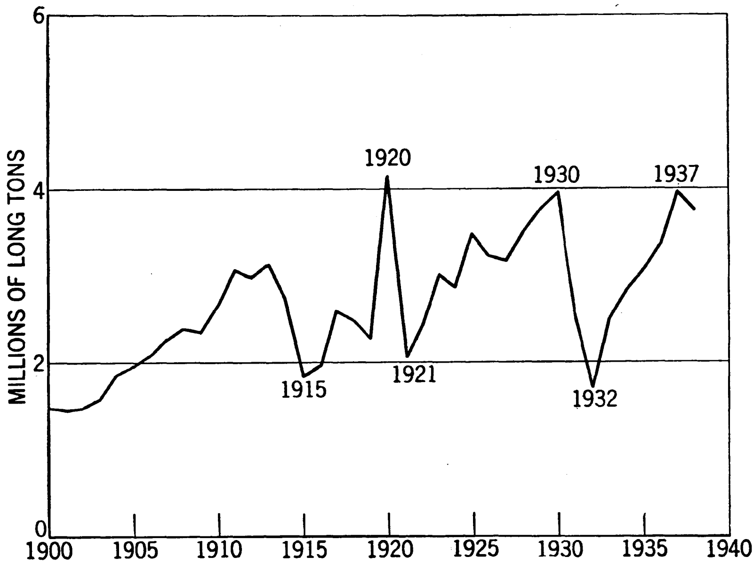

FIGURE 1.—Marketed production of United States phosphate rock, 1900–1938.

shipments from domestic mines fell from the 4-million-ton level into the broad horizontal trending zone within which they have fluctuated since the World War. (See fig. 1.) In 1938 exports were slightly greater than in 1937, but mine production, shipments, imports, and apparent consumption were all less than in 1937. Notwithstanding immense reserves, excess productive capacity, and adequate labor supply, general economic conditions have restricted domestic demand, and competition from superabundant foreign supplies has impeded further growth of export trade.

Salient statistics of the phosphate-rock industry in the United States, 1937–38

	1937			1938		
	Long tons	Value at mines		Long tons	Value at mines	
		Total	Average		Total	Average
Production (mined)	4,261,416	(1)	(1)	3,860,476	(1)	(1)
Sold or used by producers:						
Florida:						
Land pebble [2]	2,872,413	$8,600,512	$2.99	2,528,808	$7,993,665	$3.16
Soft rock	60,256	200,271	3.32	53,479	178,093	3.33
Hard rock	64,151	342,202	5.33	125,048	601,922	4.81
Total, Florida	2,996,820	9,142,985	3.05	2,707,335	8,773,680	3.24
Tennessee [2] [3]	825,099	3,343,108	4.05	899,298	3,725,601	4.14
Idaho	83,436	356,037	4.27	66,014	296,595	4.49
Montana	50,834	133,138	2.62	66,491	155,917	2.34
South Carolina				100	350	3.50
Virginia	(3)	(3)	(3)	(3)	(3)	(3)
Total, United States	3,956,189	12,975,268	3.28	3,739,238	12,952,143	3.46
Imports	13,400	[4] 115,926	[4] 8.65	7,006	[4] 80,539	[4] 11.50
Exports	1,052,802	[5] 5,818,231	[5] 5.53	1,140,841	[5] 6,637,638	[5] 5.82
Apparent consumption [6]	2,916,787	(1)	(1)	2,605,403	(1)	(1)
Stocks in producers' hands, Dec. 31:						
Florida	1,344,000	(1)	(1)	1,285,000	(1)	(1)
Tennessee [3] [7]	236,000	(1)	(1)	224,000	(1)	(1)
Other	2,000	(1)	(1)	3,000	(1)	(1)
Total stocks	1,582,000	(1)	(1)	1,512,000	(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 May 20, 1938, the President of the United States in a special message to Congress called attention to the heavy drain on the supposedly limited phosphate reserves of Tennessee and Florida, and recommended the appointment of a joint congressional committee to study the "entire subject of phosphate resources, their use and service to American agriculture." Senate Joint Resolution 298, approved June 16, 1938, authorized an investigation by such a joint committee of the House and Senate, headed by Senator Pope, of Idaho, and hearings were held at Washington, D. C.; Pocatello, Idaho; Knoxville, Tenn.; and Lakeland, Fla. A report [1] of this committee was presented to Congress in January 1939. On July 2, 1938, pending the results of the congressional investigation, Secretary of the Interior Harold L. Ickes ordered suspension of the granting of phosphate-mining leases on the public domain.

Phosphate rock, although essential to our national defense and necessary to the production of foodstuffs in war or peace, is not classed as either a strategic or critical mineral. Reserves in the United States are large, and production is potentially much greater than any anticipated need. The main producing area (Florida), however, lies within a few miles of the Atlantic coast, and many of the country's super-

1 Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States, 76th Cong., 1st sess., Report on the Phosphate Resources of the United States: S. Doc. 21, Washington, D. C., 1939, 11 pp.

phosphate plants are in Atlantic coast cities, within easy reach of attack by sea.

The situation of the leading world powers with respect to phosphate rock is covered by McGrath and Jones [2] and Emeny.[3]

Several general papers on the phosphate-rock industry appeared during 1938.[4]

Production.—Mine production of phosphate rock in the United States was about 400,000 tons less in 1938 than in 1937. Output decreased markedly in Florida and slightly in the Western States but increased in Tennessee. Virginia again yielded apatite in nelsonite ores. Phosphate mining in South Carolina was resumed in 1938 on a small scale in the Coosaw River region.

Phosphate rock mined in the United States, 1929–38, by States, in long tons

Year	Florida	Tennessee	Western States	United States	Year	Florida	Tennessee	Western States	United States
1929	3, 100, 505	647, 711	39, 039	3, 787, 255	1934	2, 464, 969	[1] 394, 311	38, 958	2, 898, 238
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

[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 rock sold or used by producers in 1938 was 5 percent less than in 1937. However, it exceeded that in any other years except 1920, 1929, and 1930. (See fig. 1.) The total value of shipments in 1938 was less than 1 percent below 1937.

Phosphate rock sold or used by producers in the United States, 1934–38

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1934	2, 834, 523	$10, 040, 005	$3. 54	1937	3, 956, 189	$12, 975, 268	$3. 28
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				

[2] McGrath, J. S., and Jones, L. M., World Production of Minerals and Economic Aspects of International Mineral Policies: Bureau of Mines, Minerals Yearbook 1935, pp. 19–25.
[3] Emeny, Brooks, The Strategy of Raw Materials: Macmillan Co., New York, 1934, 202 pp.
[4] Jacob, K. D., Phosphate Rock (in 1937): Mineral Ind., vol. 46, 1938, pp. 459–477.
Pit and Quarry, Gypsum, Phosphate, Feldspar Industries Make Important Gains: Vol. 30, No. 7, January 1938, pp. 74–76, 125.
Bowles, Oliver, Industrial Minerals, Outstanding Advances in Technology and Uses: Min. and Met., vol. 19, No. 373, January 1938, pp. 56–61.
Haynes, W., Phosphates, Threat or Promise: Chem. Ind., vol. 42, 1938, pp. 387–391.
Brand, C. J., Our Phosphate Problem: Manufacturer's Record, vol. 107, No. 6, June 1938, pp. 20, 40.
Killefer, D. H., What's New in Phosphorus: Ind. and Eng. Chem., vol. 30, No. 9, September 1938, pp. 967–972.
Brand, C. J., Of Soils, and Crops and Men: Proc. 14th Ann. Convention Nat. Fertilizer Assoc., 1938, pp. 38–52.
Schreiner, Oswald, Merz, A. R., and Brown, B. E., Fertilizer Materials: Soils and Men, Yearbook of Agriculture, 1938, U. S. Dept. of Agriculture, pp. 487–521.
The Fertilizer Review (Special Phosphate Number): Vol. 13, No. 4, July–August 1938.
Tyler, Paul M., and Johnson, Bertrand L., The Phosphate Situation: Min. and Met., September 1938, pp. 389–393.
Johnson, Bertrand L., Potash and Phosphate Rock: Min. Cong. Jour., vol. 25, No. 2, February 1939, pp. 45–46.
Pit and Quarry, Gypsum, Phosphate, Feldspar, Other Groups Record Important Advances: Vol. 31, No. 7, January 1939, pp. 71–76, 79.

Distribution of sales.—Sales of low-grade rock (below 60 percent B. P. L.) have increased steadily from 4 percent of the total sales in 1933 to 12 percent in 1938 (450,858 long tons). This trend results from the development of electrothermic smelting of low-grade phosphatic material, the re-treatment of land-pebble wastes by flotation, and the utilization of the low-grade, hard-rock, waste-pond phosphates. Most sales of phosphate rock however, remain of grades above 68 percent B. P. L.

The following table, showing distribution of sales by classes of consumers, is compiled from reports of domestic producers of phosphate rock.

Superphosphate manufacture is by far the largest outlet for domestically produced phosphate rock, although the manufacture of nonfertilizer phosphate chemicals has increased greatly.

Phosphate rock sold or used by producers in the United States, 1937–38, by grades, uses, and classes of consumers

	1937		1938	
	Long tons	Value	Long tons	Value
Grades—B. P. L.[1] content (percent):				
Below 60	319,584	(2)	450,858	(2)
60 to 66	6,517	(2)	100	(2)
68 basis, 66 minimum	468,846	(2)	378,847	(2)
70 minimum	408,105	(2)	387,501	(2)
72 minimum	959,628	(2)	904,701	(2)
75 basis, 74 minimum; 75 minimum	1,039,383	(2)	914,664	(2)
77 basis, 76 minimum; 77 minimum	330,949	(2)	327,951	(2)
Above 85 (apatite)	(3)	(2)	(3)	(2)
Undistributed [4]	423,177	(2)	374,616	(2)
	3,956,189	$12,975,268	3,739,238	$12,952,143
Uses:				
Superphosphates	2,391,245	(2)	2,074,779	(2)
Phosphates, phosphoric acid, and ferrophosphorus	492,805	(2)	443,086	(2)
Direct application to soil	85,133	(2)	83,069	(2)
Fertilizer filler	44,522	(2)	24,746	(2)
Stock and poultry feed	3,324	(2)	5,904	(2)
Undistributed [5]	939,160	(2)	1,107,654	(2)
	3,956,189	12,975,268	3,739,238	12,952,143
Classes of consumers:				
Affiliated companies	967,395	2,994,554	959,717	3,182,569
Other domestic consumers	2,066,241	6,087,249	1,679,615	5,291,308
Export [6]	922,553	3,893,465	1,099,906	4,478,266
	3,956,189	12,975,268	3,739,238	12,952,143

[1] Bone phosphate of lime.
[2] Figures not available.
[3] Included under "Undistributed"; Bureau of Mines not at liberty to publish figures.
[4] Includes grades of B. P. L. content between 68 and 70; 71; between 73 and 74; 78/76; 78; and above 85 percent; also dust, B. P. L. content not known.
[5] Includes exports, some calcined phosphate, and phosphatic material used in pig-iron blast furnaces, in the manufacture of concentrated fertilizers, as filler in asphalt mixtures, and as foundry facings.
[6] As reported to the Bureau of Mines by producers (exclusive of exports by dealers, etc.).

Consumption.—The apparent domestic consumption of phosphate rock in 1938 (2,605,403 tons) was about 300,000 tons less than that in 1937. A diagram on page 1171 of Minerals Yearbook 1938 shows the calculated extension of the logistic curve fitted to the domestic consumption of phosphate rock. The actual figures for 1938 tend to confirm the decreasing rate of increase and sidewise trend in domestic consumption forecasted by the logistic curve.

Prices.—Domestic quotations in the trade journals for the various grades of phosphate rock were unchanged throughout 1938, but in January 1939 a slight increase was reported in the price of the 68-percent B. P. L. grade of land pebble ($1.85 to $1.90) and larger decreases were reported in the prices for the higher grades. The 70-percent B. P. L. grade decreased from $2.35 to $2.15, the 72-percent grade from $2.85 to $2.40, and the 75-percent grade from $3.85 to $2.90. Such quotations, however, have been purely nominal in recent years, most actual sales having been made under contract.

Reserves.—Improved methods are making it possible to mine hitherto inaccessible deposits of phosphate rock and to utilize lower-grade deposits and waste dumps that could not have been worked profitably under old conditions. Previous estimates of reserves on higher-grade rock [5] were inadequate, and new estimates were needed. The new estimates, prepared in 1938 by the phosphate-mining industry, have been tabulated and discussed by Waggaman,[6] consulting engineer for the Phosphate Rock Institute, and his table comparing the old with the new estimates of reserves follows.

Old and new estimates of phosphate reserves in selected States, by kind of rock

[Thousands of long tons]

State and kind of phosphate rock	Old estimates [1]		New estimates [2]	
	Phosphate rock, basis 70 percent B. P. L.	Equivalent elemental P	Phosphate rock, basis 35–70 percent B. P. L.	Equivalent elemental P
Western States (Idaho, Montana, Utah, and Wyoming):				
Rock containing—				
70 percent B. P. L.	6,569,259	919,696	6,569,259	919,696
55 percent B. P. L.			[3] 13,138,519	1,445,237
Total western reserves	6,569,259	919,696	19,707,778	2,364,933
Tennessee:				
Brown rock	18,131	2,538	[4] 106,000	11,660
Blue rock (70 percent B. P. L.)	83,233	11,653	86,000	12,040
White rock			[4] 23,000	2,530
Phosphatic limestone			[5] 5,300,000	477,000
Total Tennessee reserves	101,364	14,191	5,515,000	503,230
Florida:				
Hard rock	7,686	1,076	[4] 2,000,000	220,000
Pebble	544,566	76,239	[4] 3,000,000	330,000
Soft rock			[4] 1,000,000	110,000
Bedrock (35 percent B. P. L.)			[6] 20,000,000	1,400,000
Total Florida reserves	552,252	77,315	26,000,000	2,060,000
Grand total	7,222,875	1,011,202	51,222,778	4,928,163

[1] Jacob, K. D., Phosphate Rock Reserves of the United States: Commercial Fertilizer Yearbook, 1938, pp. 28–43, 55, 59.
[2] Estimates made for Joint Congressional Committee Investigating Phosphate Reserves of the United States (November 1938).
[3] According to G. R. Mansfield; previous estimates of western reserves can be multiplied by 3 if lower-grade rock is considered.
[4] 55 percent B. P. L. and better.
[5] 45 percent B. P. L. and better.
[6] 35 percent B. P. L.

[5] Jacob, K. D., The Phosphate Rock Reserves of the United States: Commercial Fertilizer Handbook, 1938, pp. 28–43, 55, 59.
[6] Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.

The old estimate was based on phosphate rock averaging approximately 70 percent B. P. L., because only rock of this grade or better was considered suitable for the manufacture of superphosphate. The new estimate is based on material containing as low as 45 percent B. P. L. or capable of being beneficiated to this concentration and used in electric furnaces to produce elemental phosphorus. This estimate also includes as possible reserves huge quantities of phosphatic limestone in Tennessee and the phosphatic bedrock (Hawthorne formation) of the Florida land-pebble field. At present neither is used as a source of phosphorus, but small quantities of the former are used as chicken grit. Even if these low-grade formations are excluded, however, the new estimate is three to four times as large as the previous estimate in terms of phosphate rock and three times as large in terms of elemental phosphorus. If they are included, the present estimate is over seven times the older tonnage figures and is five times as large in terms of elemental phosphorus. The new estimates indicate a supply sufficient at the present rate of consumption for over 10,000 years and in Florida alone for 4,000 years.

Maynard[7] has discussed the preparation of these new reserve figures.

REVIEW BY STATES

FLORIDA

Although phosphate-rock production in Florida in 1938 was considerably less than in 1937, this State easily retained its leading position, producing three times as much as its nearest competitor, Tennessee. Both the quantity and value of the land-pebble and soft-rock shipments decreased, but shipments and value of hard rock increased. Producers of land pebble and hard rock in 1938 were the same as in the 2 previous years. (See Minerals Yearbook 1937, pp. 1318 and 1319.) Sintered phosphate matrix was made by the Pembroke Chemical Co., Pembroke, Fla., and shipped to Europe for further processing. Production of elemental phosphorus in Florida was begun in January 1938 at the only electric-furnace plant for that purpose in Florida—that of the Phosphate Mining Co. at Nichols, Fla.

Seven large companies operated in the land-pebble field. Three of these (International Agricultural Corporation, American Agricultural Chemical Co., and Amalgamated Phosphate Co.) contributed 61 percent of the total shipments in 1938. In the hard-rock field only three companies operated. The limited output of soft rock was made by several small concerns.

Billions of tons of phosphate rock that can be processed economically by present technologic methods are now believed to occur in Florida, where hitherto only a few hundred million tons had been estimated. New estimates, made by the phosphate-rock industry, quintuple the former estimates of land-pebble reserves, increase those of hard rock over 200 times, and add a billion tons for soft phosphate. The extensive but inadequately prospected Tertiary Hawthorne formation underlying the land-pebble field, which is known to carry high-grade phosphate rock in several spots, is also included in the estimates as a possible source of 20 billion tons of phosphate rock,

[7] Maynard, Poole, New Data on Our Phosphate Reserves: Chem. Ind., vol. 44, No. 1, January 1939, pp. 26–27.

making the estimated total reserves of Florida phosphate rock containing over 35 percent B. P. L. equal to 26 billion tons.

The results of Government prospecting on certain public phosphate lands in Florida were given in a press release [8] late in 1938.

Trends in the technology, employment, and output per man in the phosphate-rock industry in Florida since 1880 are covered in a recent report by A. Porter Haskell, Jr., and O. E. Kiessling.[9] The new phosphate plant of Swift & Co. was described by Trauffer.[10]

Florida phosphate rock sold or used by producers, 1934–38

Year	Hard rock: Long tons	Hard rock: Value at mines: Total	Hard rock: Value at mines: Average	Soft rock [1]: Long tons	Soft rock [1]: Value at mines: Total	Soft rock [1]: Value at mines: Average
1934	91,134	$523,783	$5.75	28,896	$86,447	$2.99
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

Year	Land pebble: Long tons	Land pebble: Value at mines: Total	Land pebble: Value at mines: Average	Total: Long tons	Total: Value at mines: Total	Total: Value at mines: Average
1934	2,249,304	$7,466,087	$3.32	2,369,334	$8,076,317	$3.41
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

[1] Includes material from waste-pond operations.
[2] Includes sintered matrix.

SOUTH CAROLINA

After many years South Carolina again has become a producing State. In 1938, 100 tons of phosphate rock were mined and exported from the Coosaw River region by the General Phosphate Corporation.

As a result of recent technologic improvements in the manufacture of phosphoric acid and elemental phosphorus, phosphate rock of even lower average grade than that formerly produced in South Carolina is now utilized in both Florida and Tennessee, and the joint congressional investigating committee's report suggests that "the Nation's lesser deposits [of phosphate rock], such as those in Arkansas and South Carolina, should be developed and conserved in the principal interest of the areas immediately surrounding them."

The history of the phosphate-rock industry of South Carolina has recently been covered in an unpublished report by Helen F. Mappus.[11]

[8] United States Department of the Interior, Government Explores Public Phosphate Lands in Florida, Results of Geological Survey Investigations: Memorandum for the Press, November 16, 1938, 3 pp.
[9] Haskell, A. Porter, Jr., and Kiessling, O. E., Technology, Employment, and Output Per Man in Phosphate-Rock Mining, 1880–1937: W. P. A., Nat. Research Project, in cooperation with U. S. Department of Interior, Bureau of Mines, Rept. E-7, Philadelphia, November 1938, 130 pp.
[10] Trauffer, W. E., New Phosphate Plant of Swift & Co.: Pit and Quarry, vol. 31, No. 6, December 1938, pp. 32–36, 40.
[11] Mappus, Helen F., The Phosphate Industry of South Carolina: Master's Thesis, Univ. South Carolina, 1935, 92 pp.

TENNESSEE

Tennessee again established a new record in phosphate-rock production in 1938, the quantity and value of its shipments being greater than ever before. Brown rock was shipped from Maury, Giles, Davidson, and Williamson Counties. No blue or white rock was mined or shipped during the year. Total stocks of phosphate rock in producers' hands in Tennessee at the close of 1938 were somewhat lower than at the end of 1937.

Tennessee phosphate rock sold or used by producers, 1934–38

[Includes apatite from Virginia]

Year	Long tons	Value at mines		Year	Long tons	Value at mines	
		Total	Average			Total	Average
1934 [1]	425,952	$1,815,678	$4.26	1937 [1] [2]	825,099	$3,343,108	$4.05
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				

[1] Separate figures for brown rock and blue rock cannot be given without disclosing confidential data regarding blue-rock production.
[2] Includes sintered matrix.

In each year since 1935, six phosphate-rock mining companies (Armour Fertilizer Works, Charleston Mining Co., Federal Chemical Co., Hoover & Mason Phosphate Co., International Agricultural Corporation, and the Monsanto Chemical Co.) have, together with the Tennessee Valley Authority, produced 98 percent or more of the total annual production of Tennessee. In 1938 these seven producers contributed over 99 percent of the total for the State. The three leading producers—Charleston Mining Co., International Agricultural Corporation, and Monsanto Chemical Co.—furnished 63 percent of the State total in 1938.

Reports describing recent developments in the Tennessee phosphate-rock industry,[12] the Hoover & Mason plant,[13] and the technology, employment, and output per man in the Tennessee phosphate-rock industry, 1880–1937,[14] have been published lately.

The Victor Chemical Works completed the construction of its electric-furnace plant for the production of elemental phosphorus at Mount Pleasant, Tenn., and began operations June 1, 1938, the material for the furnace being furnished by the Charleston Mining Co.

Tonnage production of elemental phosphorus by the electric-furnace plant of the Monsanto Chemical Co., near Columbia, Tenn., has made available such quantities of pure dry phosphorus pentoxide that the price in carload lots was cut 33⅓ percent in 1938, or from 18 to 12 cents a pound.

Increasing quantities of low-grade phosphatic materials are being mined in Tennessee largely for use in the electric-furnace production of elemental phosphorus. In 1938, 39 percent of the total production of the State was brown rock or matrix containing less than 60 percent B. P. L. The Charleston Mining Co., Monsanto Chemical Co., and

[12] Tyler, P. M., and Mosley, H. R., Recent Developments in the Tennessee Phosphate-Rock Industry: Am. Inst. Min. and Met. Eng. Tech. Pub. 1053, February 1939, 22 pp.
[13] Rock Products, Modern Tennessee Phosphate Plant Solves Problem of Recovery of Fines: Vol. 41, No. 8, August 1938, pp. 34–38.
[14] See footnote 9.

the Tennessee Valley Authority produced this low-grade material for electric-furnace uses and the Harsh Phosphate Co. for fertilizer fillers.

New estimates [15] of the phosphate-rock reserves in Tennessee, made by the phosphate-rock industry, place the quantity at 5 to 6 billion tons of phosphate rock containing over 45 percent B. P. L. The new estimate of reserves of brown, blue, and white phosphate rock combined is only double the previous estimate of about 100 million tons, the increase being due to the inclusion of figures for white rock and much enlarged figures for brown rock. The big increase in the new estimate of total reserves, however, is due to the inclusion of more than 5 billion tons for the at present unworked phosphatic limestones of the Central Basin of Tennessee, now believed amenable to present-day flotation or calcination treatment to produce products suitable for furnace processes or acidulation. These limestones were not included in the previous estimate, as at that time they were not considered of commercial value.

Mining operations of the Tennessee Valley Authority were in progress in 1938 both on its own and leased lands in the brown-rock field. According to its annual report, the T. V. A. at the end of the fiscal year 1937–38 held phosphate leases on 11 properties totaling 1,999 acres in Maury, Sumner, and Perry Counties and owned fee simple title to or mineral rights in 1,825 acres in tracts in Maury and Williamson Counties. Some of the matrix mined for T. V. A. during 1938 was exchanged for sintered phosphate rock produced by the Monsanto Chemical Co., which was shipped together with the remainder of the rock mined and rock purchased to the Muscle Shoals (Ala.) plant of the T. V. A.

T. V. A. continued research on the production of concentrated phosphate fertilizers. A small commercial-size unit manufacturing calcium metaphosphate was operated successfully, and 4,246 tons of calcium metaphosphate were manufactured during the fiscal year, production at the end of that period being at the rate of 30 tons a day. During the year a third electric furnace of approximately the same capacity as each of the other two was put into operation, and a new phosphoric acid plant was completed and successfully operated. The furnaces produced phosphorus for the metaphos unit and phosphoric acid for 45,759 tons of concentrated superphosphate containing about 43 to 46 percent P_2O_5.

Several articles were published in 1938 covering T. V. A. phosphate operations.[16]

A report of the findings of an interdepartmental committee appointed by the Secretaries of Agriculture and Interior in response to a request of the Joint Congressional Committee on the Investigation of the Tennessee Valley Authority was released November 9, 1938. This report contained the results of a scientific survey and technical investigation of the phosphate purchases of the T. V. A.

[15] Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.
Maynard, Poole, New Data on our Phosphate Reserves: Chem. Ind., vol. 44, No. 1, January 1939, pp. 26–27.

[16] Curtis, H. A., Miller, A. M., and Newton, R. H., Process Developments at T. V. A. Phosphoric Acid Plant: Chem. and Met. Eng., vol. 45, No. 4, April 1938, pp. 193–197.
Curtis, H. A., Copson, R. L., Abrams, A. J., and Junkins, J. N., Full Scale Production of Metaphosphate Achieved at Wilson Dam: Chem. and Met. Eng., vol. 45, No. 6, June 1938, pp. 318–322.
Newton, R. H., T. V. A.'s Phosphate Smelting Results: Chem. and Met. Eng., vol. 45, No. 7, July 1938, pp. 374–379.

VIRGINIA

The Southern Mineral Products Corporation (a subsidiary of the Vanadium Corporation of America) operated its milling plant at Piney River, Nelson County, Va., and recovered apatite concentrates from nelsonite ore from its mines in Amherst County, Va. The quantity of apatite concentrates recovered, sales, and stocks on hand at the end of the year increased in 1938 over 1937.

WESTERN STATES

In 1938 Idaho and Montana were the only phosphate-rock-producing States in the West. In Idaho there was only one producing company in 1938, as in recent years—the Anaconda Copper Mining Co., which operated its No. 3 mine at Conda, Caribou County. In Montana there were two producers—one large and one small. The Montana Phosphate Products Co., Trail, British Columbia, operated the Anderson mine near Garrison, Powell County, and United States Government Leases 076740 and 081920, supplying the requirements of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail. Some of the product from these operations was ground by William Anderson at the mill near Garrison for direct application to the soil. The Mineral Hill Mining Co. (Cronin and Crowley) in 1938 made a relatively small output from its mine near Avon, shipping its product to the Anaconda Copper Mining Co. fertilizer plant at Anaconda, Mont.

The mine at Cokeville, Wyo., was not operated in 1938, but in 1937 a carload of phosphate rock was taken from this mine and shipped to the T. V. A. plant at Wilson Dam, Ala., for experimental work.

Most western phosphate rock is processed chemically at the plant of the Anaconda Copper Mining Co. at Anaconda, Mont., and that of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, British Columbia. Both plants treat the phosphate rock with sulfuric acid, producing "triple" (or "treble") superphosphate. The plant at Trail, because of its synthetic ammonia operations, also makes ammonium phosphate and mixtures of ammonium phosphate and ammonium sulfate. A considerable part of the Canadian product comes back to American farms and citrus growers in the Western States.

Phosphate rock from Idaho is also used for the production of phosphate chemicals, in pig-iron blast-furnace charges, for the preparation of ordinary superphosphate in California, and for direct application to the soil.

A few articles regarding the deposits and operations of the Western States were published during the year.[17]

The Joint Congressional Committee to Investigate the Adequacy and Use of the Phosphate Resources of the United States [18] recommended that—

[17] Curtis, H. A., Western Phosphate Deposits: Ind. and Eng. Chem., vol. 30, No. 9, September 1938, pp. 973–979.
Waggaman, W. H., Our Phosphate Reserves: Chem. and Met. Eng., vol. 46, No. 2, February 1939, pp. 66–68.
Chemical and Metallurgical Engineering, What About Western Phosphates: Vol. 45, No. 9, September 1938, pp. 486–487.
Pike, R. D. [Potash-Phosphate Fertilizer from Western Rock]: Chem. and Met. Eng., vol. 46, No. 2, February 1939, p. 86.
Hubbard, J. S., Lower Mining Costs: Chem. and Met. Eng., vol. 46, No. 2, February 1939, p. 86.

[18] See footnote 1.

A plant for experimental, educational, and demonstration purposes be established in the vicinity of the vast western deposits of phosphate, in order that those resources which are mainly located on public lands be conserved and wisely used for the benefit of American agriculture. Until such plant can be established, we recommend that the Tennessee Valley Authority conduct experiments with western phosphate ores, with particular reference to combination of potash and phosphate fertilizer products suitable for western soils.

Western States phosphate rock sold or used by producers, 1934–38

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
1934	37,151	$140,397	$3.78	2,086	$7,613	$3.65	39,237	$148,010	$3.77
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

FOREIGN TRADE [19]

Imports.—Imports of phosphate rock into the United States in 1938 were limited to 2 long tons of apatite from Brazil and 7,004 tons of phosphate rock, mostly from French Oceania (6,300 tons) and Netherland West Indies (Curaçao) (701 tons). Three tons came from British Malaya.

Curaçao phosphate rock is outstanding because of its low fluorine content (less than 1 percent). Jacob and others [20] state that—

In proportion to the phosphoric acid content, Curaçao phosphate contains less fluorine than any of the other calcium phosphate rocks for which data are available.

Phosphate rock and phosphatic fertilizers imported for consumption in the United States, 1934–38

Fertilizer	1934		1935		1936		1937		1938	
	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)
Ammonium phosphates, used as fertilizer	9,955	$390,023	10,812	401,431	13,383	475,483	27,253	$1,089,657	29,028	1,286,935
Bone dust, or animal carbon, and bone ash, fit only for fertilizing	15,948	308,873	18,388	354,900	23,215	465,585	37,341	857,349	19,581	393,808
Guano	16,638	337,136	16,219	311,645	22,804	457,209	13,104	375,650	15,199	717,817
Slag, basic, ground or unground	131	2,009	1,078	15,136	758	9,758	714	7,339	691	9,547
Precipitated bone, fertilizer grade			472	11,613	3,817	96,166	4,414	120,225	3,385	98,725
Phosphates, crude, not elsewhere specified	(2)	(2)	(2)	(2)	(2)	(2)	13,400	115,926	7,004	80,534

1 Not shown separately; included with "Phosphates, crude, not elsewhere specified" beginning Jan. 1, 1937.
2 New classification beginning Jan. 1, 1937.

19 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.
20 Jacob, K. D., Hill, W. L., Marshall, H. L., and Reynolds, D. S., The Composition and Distribution of Phosphate Rock, with Special Reference to the United States: U. S. Dept. Agriculture Tech. Bull. 364, June 1933, p. 39.

Exports.—Exports in 1938 were a little over a million tons and slightly exceeded 1937, both in quantity and value. The average value per ton of exports of phosphate rock increased from $5.53 in 1937 to $5.82 in 1938. The phosphate rock exported in 1938 came from Florida, South Carolina, and the Western States. Figure 2

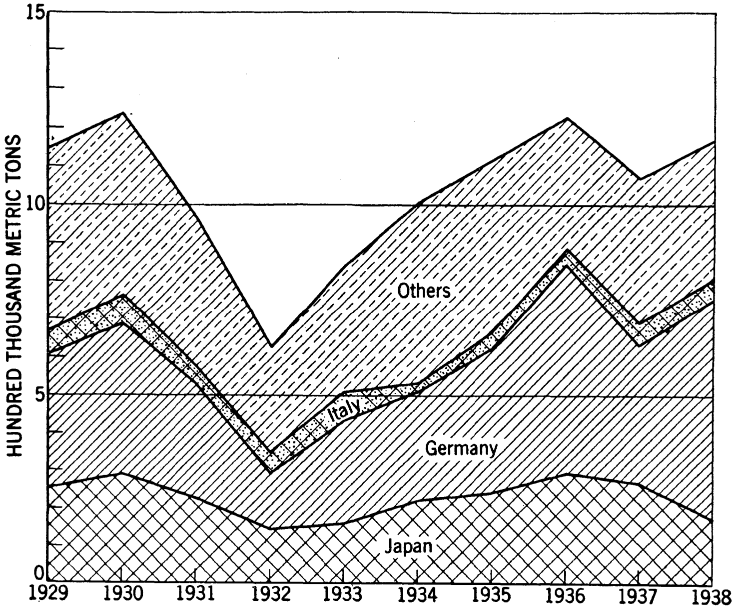

FIGURE 2.—Exports of phosphate rock from United States to Germany, Japan, Italy, and other countries, 1929-38.

shows the trends in total phosphate exports and in exports to the two largest importers of domestic phosphate—Germany and Japan—as well as to Italy.

Phosphate rock exported from the United States, 1934-38

Year	Long tons	Value: Total	Value: Average	Year	Long tons	Value: Total	Value: Average
1934	993,493	$5,008,532	$5.04	1937	1,052,802	$5,818,231	$5.53
1935	1,104,394	5,773,506	5.23	1938	1,140,841	6,637,638	5.82
1936	1,208,951	6,776,917	5.61				

The quantity and value of exports of both hard rock and land pebble increased in 1938 over 1937. The quantity and value of exports of other phosphatic materials, principally sintered phosphate matrix, were 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 1934 to 1938, inclusive.

Phosphate rock exported from the United States, 1934–38, by countries

HIGH-GRADE HARD ROCK

Country	1934		1935		1936		1937		1938	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Australia	2,133	$16,471								
Belgium	5,325	37,275			4,300	$30,100	4,250	$29,750	4,000	$28,000
British Malaya									507	5,000
British West Indies ("Other")			2	$40						
Canada	823	8,628	28,907	121,686	39,271	274,934	49,970	305,865	67,134	406,463
Germany	38,100	266,700	49,880	349,160	72,400	507,950	31,457	216,016	57,250	369,787
Italy									3,000	18,750
Japan							1	11		
Lithuania	7,000	49,000	6,000	42,000			12,150	85,050		
Netherlands	14,600	102,200	19,575	137,025	15,050	115,350	1,800	12,600	14,450	94,420
Panama	1	31	4	31			50	812	4	48
Poland and Danzig					7,700	53,900			2,900	18,125
Sweden	29,630	192,595	25,700	169,075	25,225	174,350	20,800	145,600	32,675	219,425
	97,612	672,900	130,068	819,017	163,946	1,156,584	120,478	795,704	181,920	1,160,018

LAND PEBBLE

Country	1934		1935		1936		1937 [1]		1938 [1]	
	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	5,781	$32,301
Belgium	4,986	$30,804	3,293	16,794	77,972	478,384	88,050	546,730	96,073	588,299
British West Indies ("Other")	5	99								
Canada	28,650	164,939	29,562	160,028	37,853	165,166	60,174	267,983	59,275	250,465
Czechoslovakia					5,983	30,114	29,494	185,867	26,238	155,987
Denmark	32,013	143,817	36,186	159,242			7,331	34,404	7,495	33,503
Finland	3,500	14,875								
France	3,006	15,480	3,671	20,374						
Germany	143,882	740,458	211,179	1,157,410	278,404	1,660,508	189,603	1,104,534	358,077	2,181,869
Hungary					4,852	24,163	26,266	135,330	10,017	69,107
Italy	106,760	571,107	60,643	359,123	65,813	393,657	69,012	426,094	49,911	305,718
Japan	213,620	880,824	222,110	952,974	281,797	1,176,953	278,155	1,153,910	159,270	664,392
Mexico									39	200
Netherlands	158,629	792,600	147,769	812,060	142,432	904,135	98,850	628,370	103,666	675,249
Norway			1,499	11,243						
Poland and Danzig	34,994	219,081	28,499	176,781	16,654	93,428	17,586	115,975	2,993	19,821
Rumania			11,298	56,490	12,852	64,260				
Spain	89,226	412,799	140,329	668,454	28,720	151,789				
Sweden	41,645	188,532	29,738	165,491	45,664	291,870	48,608	306,412	66,113	412,948
Switzerland							4,814	37,068	6,620	46,316
United Kingdom	22,693	97,419	28,659	126,776	43,008	170,901	5,488	28,940	7,353	41,445
Yugoslavia	12,272	62,798	16,891	95,499			1,496	8,602		
	895,881	4,335,632	974,326	4,954,489	1,045,005	5,620,333	932,324	5,022,527	958,921	5,477,620

[1] Excludes sintered matrix.

Other phosphate materials[1] exported from the United States, 1934–38

Year	Long tons	Value	Year	Long tons	Value
1934	6,153	$218,499	1937 [2]	55,665	$466,850
1935	3,984	154,429	1938 [2]	33,074	283,668
1936	3,489	165,385			

[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 different customs districts. In 1938 most rock of this type went from the hard-rock district in Florida to Europe, but a large quantity of high-grade hard rock was shipped from the Montana-Idaho district to Canada.

High-grade hard-rock phosphate exported from the United States, 1937–38, by customs districts

Customs district	1937		1938	
	Long tons	Value	Long tons	Value
Buffalo	324	$3,625	2	$30
Dakota	2	19	14	120
Florida	70,457	489,016	114,782	753,507
Los Angeles	1	9		
Michigan	150	1,404	70	812
Montana and Idaho	49,491	300,786	67,042	405,445
New Orleans			4	48
New York	50	812		
St. Lawrence	3	31	2	16
Washington	(1)	2	4	40
	120,478	795,704	181,920	1,160,018

1 Less than 1 ton.

WORLD PRODUCTION

World production of phosphate rock from 1934 to 1938, inclusive, is shown in the following table. Statistical details of world trade, production, and consumption of phosphate rock for 1935, 1936, and 1937 were published early in 1939.[21]

World production of phosphate rock, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Algeria	532,210	603,863	530,998	631,148	584,440
Angaur Island 1	72,148	70,468	50,803	(2)	(2)
Australia: New South Wales	210	239	178	20	(2)
Belgium	14,385	173,360	16,090		(2)
Canada	73	169	476	91	189
China 3	8,000	8,000	8,000	8,000	8,000
Christmas Island (Straits Settlements) 4	129,780	149,341	157,564	154,378	162,425
Egypt	437,933	473,896	531,031	517,002	(2)
Estonia	10,610	11,642	11,408	10,112	(2)
France	66,800	49,600	55,000	103,600	(2)
Germany	735	180	1,060	3,314	(2)
Austria		440	120		(2)
India, British	60	104	130	169	(2)
Indochina	4,600	5,888	10,336	20,252	(2)
Italy		500		200	(2)
Japan	56,500	91,248	113,102	(2)	(2)
Madagascar	8,340	6,000	5,349	4,290	(2)
Makatea Island 4	77,470	130,353	122,936	166,726	102,941
Morocco, French 5	1,266,796	1,303,182	1,257,796	1,501,767	1,447,544
Nauru and Ocean Islands 6	565,522	707,051	965,349	1,024,168	1,158,907
Netherland India	5,013	11,553	12,072	26,167	(2)
Netherland West Indies: Curaçao 4	100,627	90,709	78,131	101,837	(2)
New Caledonia	2,000	11,855	2,254	(2)	(2)
Philippine Islands	20,406	1,309	497		(2)
Poland	7,655	11,641	12,497	(2)	(2)
Rumania	1,219	2,784	1,039	(2)	(2)
Seychelles Islands 4	12,062	10,082	23,942	9,594	(2)
Spain	19,297	(2)	(2)	(2)	(2)
Taiwan		91	213	(2)	(2)
Tanganyika Territory	208	194		104	(2)
Tunisia	1,766,000	1,500,000	1,488,000	1,771,439	1,934,200
Union of South Africa	77				
U. S. S. R. 7	382,800	767,900	920,000	(2)	(2)
United States (sold or used by producers)	2,880,017	3,091,211	3,405,654	4,019,686	3,799,253

1 Exports during fiscal year ended Mar. 31 of year following that stated.
2 Data not available.
3 Estimated (Imp. Inst., London).
4 Exports.
5 Shipments, including exports as follows: 1934, 1,255,847 tons; 1935, 1,296,052 tons; 1936, 1,247,923 tons; 1937, 1,484,562 tons; 1938, 1,427,643 tons.
6 Exports during fiscal year ended June 30 of year stated.
7 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.

21 Gray, A. N., Statistics of Phosphate Rock and Superphosphate for 1937: Superphosphate (London), vol. 12, No. 1, January 1939, pp. 2–7.

INTERNATIONAL TRADE

Statistics on trade among the various countries producing or consuming phosphate rock in 1938 are shown in a table issued by the Phosphate Export Association (New York). Diagrams embodying some of the data are included in this chapter because of the current interest in the future of Tunisia. These diagrams show destinations of exports of phosphate rock from Tunisia (fig. 3), sources of French

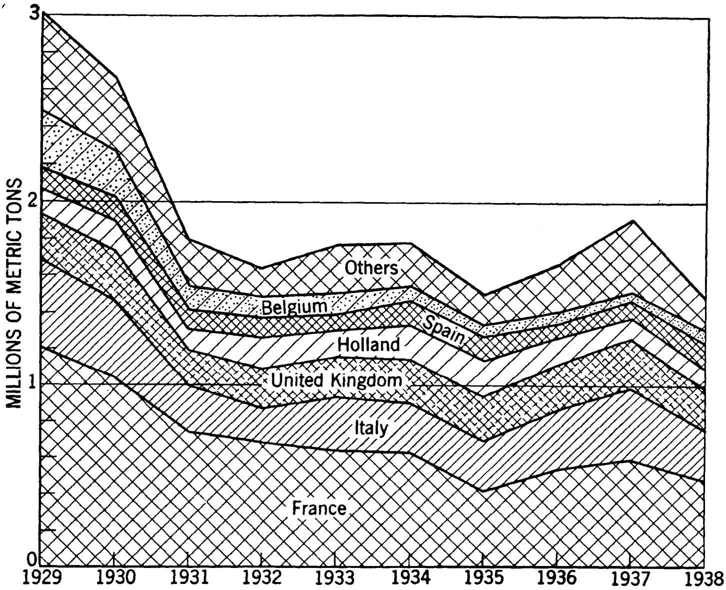

FIGURE 3.—Destinations of exports of phosphate rock from Tunisia, 1929–38.

phosphate-rock supplies (fig. 4), and sources of Italian phosphate-rock supplies (fig. 5).

TECHNOLOGY

The reactions of calcined phosphate rock (obtained by heating silica-bearing phosphate rock at 1,400° C. in the presence of water) with ammonium sulfate and superphosphate are described in a paper by Beeson and Jacob.[22]

Results of a study of the treatment of phosphate rock with by-product hydrochloric acid for the production of monocalcium chlorophosphate, a potential fertilizer material, is given in a paper by Fox and Clark.[23]

Many data on the technology of the domestic phosphate-rock industry are contained in a report by Haskell and Kiessling.[24] Articles in recent issues of the Fertilizer Review [25] also contain data on the technology of phosphate rock.

[22] Beeson, K. C., and Jacob, K. D., Chemical Reactions in Fertilizer Mixtures. Reactions of Calcined Phosphate with Ammonium Sulfate and Superphosphate: Ind. and Eng. Chem., vol. 30, No. 3, March 1938, pp. 304–308.

[23] Fox, E. J., and Clark, K. G., Monocalcium Chlorophosphate. Reaction Product of Calcium Chloride and Phosphoric Acid: Ind. and Eng. Chem., vol. 30, No. 6, June 1938, pp. 701–703.

[24] See footnote 9.

[25] The Fertilizer Review, Progress in the Mining and Processing of Phosphate Rock: Vol. 13, No. 4, July-August 1938, pp. 12–13; Phosphorus, Superphosphate, and Other Phosphorus Compounds, Vol. 14, No. 1, January-February 1939, pp. 8–10.

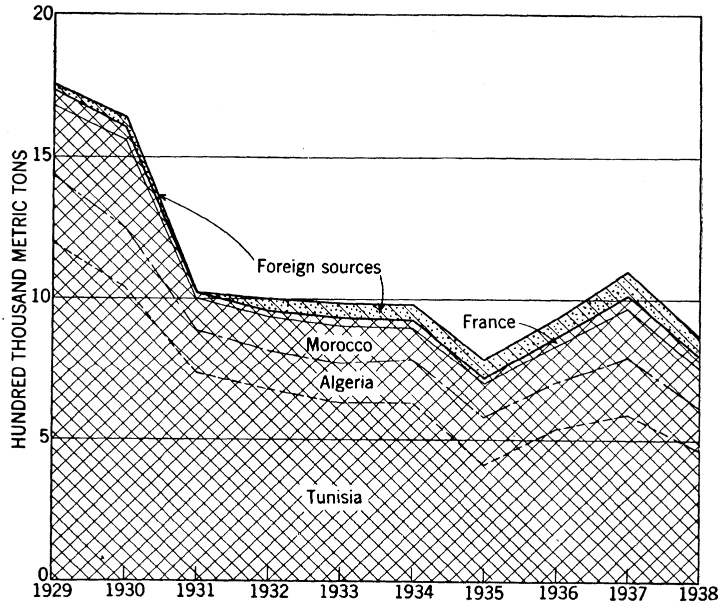

FIGURE 4.—Sources of French phosphate-rock supplies, showing relation of supplies from France and its possessions to total supplies, 1929–38.

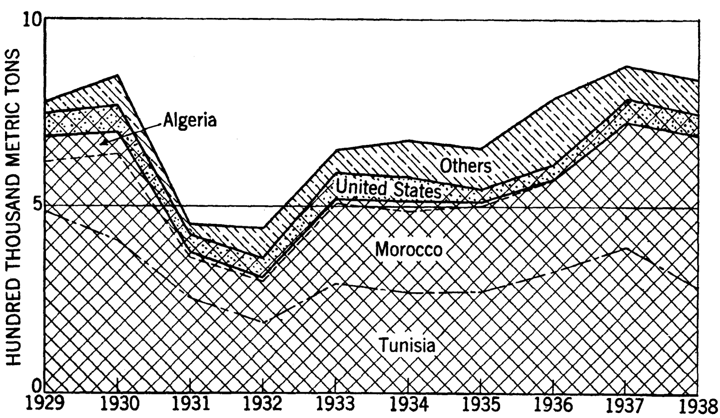

FIGURE 5.—Sources of Italian supplies of phosphate rock, showing relation of imports from French possessions to total imports, 1929–38.

SUPERPHOSPHATES

The following table shows the salient features of the superphosphate industry in the United States, 1935–38.

Summary of statistics for superphosphate industry in the United States, 1935–38

	1935	1936	1937	1938
Production: [1]				
Bulk superphosphate .... short tons..	2,954,130	3,412,486	4,429,767	3,575,588
Base and mixed goods .... do....	109,609	142,459	122,680	156,730
Shipments: [1]				
Bulk superphosphates, to consumers .... do....	824,177	997,011	1,046,334	902,490
Bulk superphosphates, to others .... do....	1,223,132	1,672,049	2,130,860	1,817,293
Base and mixed goods .... do....	1,354,728	1,480,719	1,723,590	1,537,491
Stocks in manufacturers' hands, Dec. 31: [1]				
Bulk superphosphates .... do....	1,217,767	1,133,640	1,313,327	1,361,127
Base and mixed goods .... do....	619,909	657,828	784,532	669,503
Exports of superphosphates [2] .... long tons..	54,965	68,368	78,949	90,237
Imports of superphosphates [2] .... do....	20,543	18,395	57,930	18,753
Sales of phosphate rock by producers for superphosphate production .... long tons..	1,690,554	1,768,677	2,391,245	2,074,779

[1] Bureau of the Census, Monthly Statistics Superphosphate Industry; 16 percent available phosphoric acid.
[2] 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 1937 and 1938.

Superphosphates (acid phosphates) imported into and exported from the United States, 1937–38, by countries

Country	Imports				Exports			
	1937		1938		1937		1938	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
Argentina							500	$16,070
Belgium	3,316	$180,422	2,540	$77,198				
Canada	17,514	279,184	7,333	125,426	57,038	$620,636	73,649	770,677
Chile							240	2,235
Cuba					17,487	175,632	12,282	102,822
Dominican Republic					43	1,959	32	1,173
France	136	6,300						
Jamaica					46	915		
Japan	4,449	78,213						
Mexico					65	2,390	186	9,946
Netherlands	32,515	440,141	8,880	121,769				
Philippine Islands							246	3,575
Salvador					142	5,381		
Turkey					1,375	10,999		
Union of South Africa							2,955	34,296
United Kingdom					2,582	20,530		
Venezuela							52	2,280
West Indies "Other British"					120	1,692	60	826
Other countries					51	928	35	1,451
	57,930	984,260	18,753	324,393	78,949	841,062	90,237	945,351

Statistics for 1936, covering international trade in superphosphate and production of superphosphate in various countries, were published early in 1938.[26] Several articles dealing with the technology and economics of the superphosphate industry appear in the Fertilizer Review, vol. 14, No. 1, January-February 1939.

[26] Gray, A. N., Phosphate and Superphosphate Statistics for the Year 1936; II, Superphosphate: Superphosphate (London), vol. 11, No. 2, 1938, pp. 21-27.

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BASIC SLAG

Shortly after the introduction of the basic Bessemer process in 1878 for converting pig iron into steel and simultaneously removing the phosphorus, the slag produced in the process was used as a liming material for acid and lime-deficient soils. Later the effectiveness of the phosphorus in the slag was recognized, and basic slag is now an important competitor of phosphate rock and superphosphate as a source of fertilizer phosphorus in various European countries. Basic slag contains 5 to 20 percent available phosphoric acid, and that produced in this country is sold on the basis of a content of 8 percent total phosphoric acid.[27] The domestic market is limited and is satisfied by the importation of a small quantity and by an annual production of a few thousand tons in the Birmingham iron district of Alabama.

Production of basic slag in Europe and the United States, 1934–37, in metric tons[1]

Country	1934	1935	1936	1937
Europe:				
Belgium[2]	660,000	569,000	605,000	825,000
Czechoslovakia	94,000	125,000	145,000	163,000
Eire	700		2,000	2,000
France:				
Saar	323,000	(3)	(3)	(3)
Other districts	879,000	940,000	1,035,000	1,218,000
Germany	1,358,000	[3] 2,025,000	[3] 2,277,000	[3] 2,370,000
Italy		2,000	1,000	1,000
Luxemburg	409,000	396,000	431,000	533,000
Poland		1,000	(4)	4,000
Sweden	13,000	15,000	16,000	15,000
U. S. S. R.	29,000	41,000	(4)	(4)
United Kingdom[5]	266,000	276,000	302,000	410,000
	4,031,700	4,390,000	[6] 4,814,000	[7] 5,541,000
North America: United States[2]	25,000	25,000	36,000	36,000
	4,056,700	4,415,000	[6] 4,850,000	[7] 5,577,000

[1] Adapted from figures as published by Imperial Institute, London.
[2] Estimated.
[3] Production of Saar included with Germany.
[4] Data not available.
[5] Estimated amount ground and used as fertilizers.
[6] Exclusive of Poland and U. S. S. R.
[7] Exclusive of U. S. S. R.

[27] Schreiner, Oswald, Merz, A. R., and Brown, B. E., Fertilizer Materials: U. S. Dept. Agriculture Yearbook, 1938, Soils and Men, pp. 487–521. (See pp. 501, 502, and 512.)

TALC, PYROPHYLLITE, AND GROUND SOAPSTONE[1]

By Bertrand L. Johnson and K. G. Warner

SUMMARY OUTLINE

Reacting slightly from the all-time peak year of 1937, sales of talc, pyrophyllite, and ground soapstone in 1938 declined 17,000 tons. Total sales of 212,775 short tons valued at $2,302,560 compared favorably with the levels of recent years. Sales of ground materials decreased 20,000 tons, but this decrease was partly counterbalanced by increases in sales of crude and sawed and manufactured materials. Imports of crude materials were a little larger than in 1937, but those of manufactured products were considerably less. Exports of crude and ground talc, steatite, and soapstone decreased, but exports of talcum powders increased slightly.

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 ($Al_2Si_4O_{10}(OH)_2$) instead of a hydrous magnesium silicate like talc ($Mg_3Si_4O_{10}$ $(OH)_2$). Dana [2] and other mineralogists place pyrophyllite in a kaolin division containing the kaolin minerals—kaolinite, dickite, and nacrite—and the hydrous aluminum silicates—halloysite, allophane, beidellite, and montmorillonite. Schwartz [3] places it in a trivalent hydrous metadisilicate group with kaolin, montmorillonite, and certain other minerals. Pyrophyllite has a somewhat different composition and structure [4] from kaolinite ($Al_2Si_2O_5(OH)_4$).

[1] Soapstone sold in slabs or blocks is included in the chapter on Stone.
[2] Dana, E. S., Textbook of Mineralogy: 4th ed., revised and enlarged by W. E. Ford, New York, John Wiley & Sons, 1932, pp. 639–640, 680–684.
[3] Schwartz, C. K., Classification of the Natural Silicates: Am. Mineral., vol. 22, No. 11, 1937, pp. 1073–1087; No. 12, 1937, pp. 1161–1174.
[4] Bragg, W. L., The Atomic Structure of Minerals: Cornell Univ. Press, Ithaca, N. Y., 1937, 292 pp.

Salient statistics of the talc, pyrophyllite, and ground-soapstone industry in the United States, 1937–38

	1937		1938	
	Short tons	Value	Short tons	Value
Sales by producers:				
Crude	11,087	$52,750	13,498	$72,845
Sawed and manufactured	1,101	111,680	1,729	[1] 70,268
Ground	217,811	2,397,323	197,548	2,159,447
	229,999	2,561,753	212,775	2,302,560
Imports for consumption:				
Crude and unground steatite and French chalk	324	7,644	337	5,956
Manufactures (except toilet preparations) wholly or partly finished	26,552	465,175	21,790	385,242
	26,876	472,819	22,127	391,198
Exports:				
Talc, steatite, and soapstone, crude and ground	8,878	149,625	7,118	124,194
Powders—talcum (in packages), face, and compact	(2)	966,473	(2)	978,100
	----------	1,116,098	----------	1,102,294

[1] Includes crude value of some sawed material. [2] Quantity not recorded.

Nine States produced talc, pyrophyllite, and ground soapstone in 1938. Two of these States were on the Pacific coast; the others, producing most of the output, were in the East. Both talc and soapstone were produced in California, Maryland, Vermont, and Virginia; talc only in Georgia, New York, and Washington; talc and pyrophyllite in North Carolina; and only soapstone in Pennsylvania.

SALES

Sales of talc, pyrophyllite, and ground soapstone, which totaled 212,775 short tons in 1938, were down from the peak of 1937 to the general zone of fluctuations that has marked the upper limit of sales during recent years. Decreases in total sales of more than 7 percent in quantity and 10 percent in value from 1937 reflected the decreased demand for ground talc. Sales of crude, as well as sawed and manufactured materials, increased.

Talc, pyrophyllite, and ground soapstone, sold by producers in the United States, 1934–38, by classes

Year	Crude		Sawed and manufactured		Ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	8,767	$55,659	174	$46,918	129,564	$1,346,108	138,505	$1,448,685
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	[1] 70,268	197,548	2,159,447	212,775	2,302,560

[1] Includes crude value of some sawed material.

Sales by States.—Decreased sales in 1938 were reported by all the larger talc-producing States except Georgia, which has made a new high record every year since 1932 and in 1938 increased its sales 26 percent over the 1937 figure. Increases were also achieved in Mary-

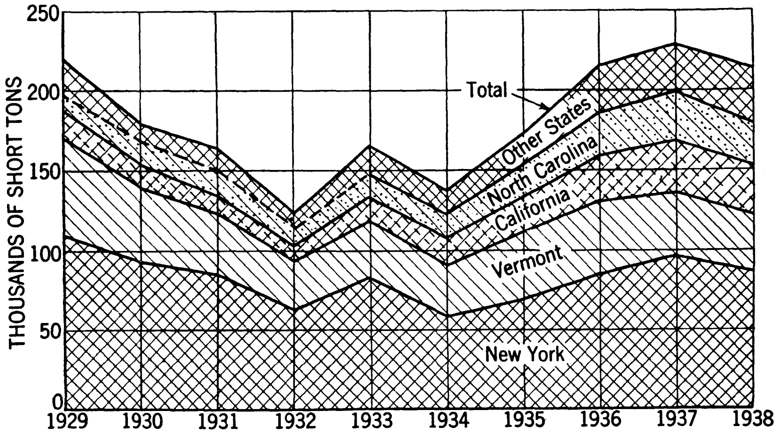

FIGURE 1.—Production of talc, pyrophyllite, and ground soapstone in the United States, 1929–38, by States.

land and Pennsylvania. Sales in both California and North Carolina dropped from the all-time highs of 1937.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1937–38, by States

State	1937		1938	
	Short tons	Value	Short tons	Value
California	32,495	$427,031	30,059	$391,456
Georgia	11,984	148,177	15,117	130,595
New York	96,140	1,215,834	86,423	1,110,024
North Carolina	28,250	271,013	27,460	241,337
Vermont	41,118	384,474	35,126	329,084
Washington	406	6,754	174	894
Other States [1]	19,606	108,470	18,416	99,170
	229,999	2,561,753	212,775	2,302,560

[1] Maryland, Pennsylvania, and Virginia.

MARKETS [5]

The domestic market for talc, pyrophyllite, and ground soapstone is the largest in the world. It not only consumes most of the large domestic production of the crude material but also absorbs the hundreds of tons of foreign talc imported each year. In 1933, a depression year, domestic industries took 162,315 short tons of talc, pyrophyllite, and ground soapstone, principally of domestic origin, and in 1937, during a period of comparative prosperity, they required 221,445 tons. The market takes most of these materials in the ground state, 98 percent of the domestic sales of talc being ground material. Less than 1 percent is in the form of sawed and manufac-

[5] *See also* Johnson, Bertrand L., Marketing Talc, Pyrophyllite, and Ground Soapstone: Bureau of Mines Inf. Circ. 7080, June 1939, 13 pp.

tured material and the rest is crude. The largest markets for industrial-grade talcs are in the northeastern quarter of the United States and along the Pacific coast. Markets exist in many industries, principally, however, in the paint, ceramics, roofing, paper, and rubber industries, which in 1938 bought 77 percent of the total sales of domestic materials. Figure 2 shows the demand in the leading markets for the past 3 years.

Although consumption in the paint, paper, rubber, and several other industries declined in 1938, sales to the roofing industry increased 17 percent, and sales for toilet preparations—a minor outlet for domestic talc—jumped 38 percent. Paint manufacture is still the principal consumer, but the relative importance of other outlets has

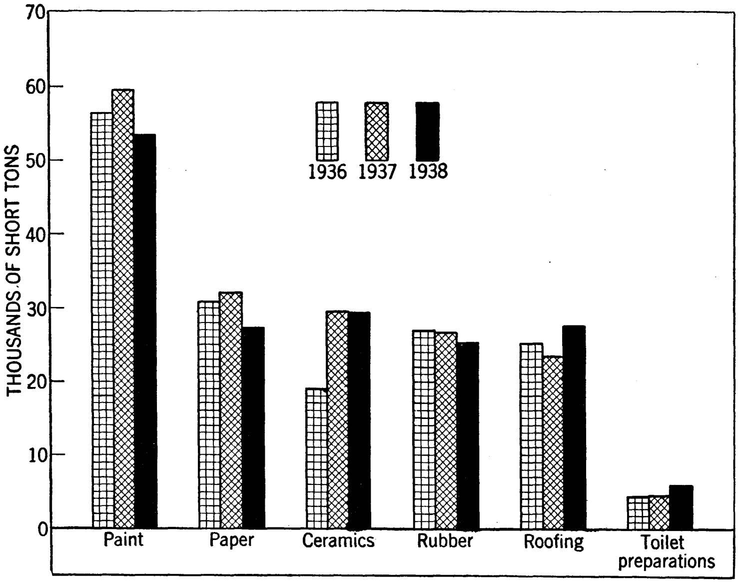

FIGURE 2.—Consumption of talc, pyrophyllite, and ground soapstone by leading consuming industries in the United States, 1936–38.

altered greatly. The ceramic industry, which took virtually the same quantity in 1938 as in 1937, is now in second place. Owing to an imposing gain, roofing climbed to third place, whereas it ranked fifth in 1937. Paper, formerly second, dropped to fourth position and rubber to fifth.

New York is the leading supplier of talc to the paint, ceramic, and paper industries, North Carolina to the rubber industry, and Vermont to the roofing industry. Pennsylvania led in supplying the needs for toilet preparations and Virginia in supplying those for foundry facings.

Almost 90 percent of the domestic talc used in paint in 1938 came from mines in New York; only minor quantities were shipped from other States, principally Pennsylvania, Vermont, California, and Maryland. New York's share of ceramic-talc sales was 48 and California's 30 percent; the remainder was chiefly pyrophyllite from North Carolina, although talc from Maryland, Vermont, and Washington also was used in ceramics. Vermont supplied about one-half of the talc used in roofing, the remainder coming from Georgia, Virginia, Maryland, North Carolina, and Washington, in the order named. More than two-thirds of the talc taken by the paper industry came from New York and almost all the remainder from Vermont. Rubber manufacturers are large users of North Carolina pyrophyllite but also use substantial quantities of talc from Vermont, Georgia, and New York. Imported talc dominates the toilet-preparations industry, but Pennsylvania, California, and North Carolina shared in the increased sales of domestic raw material to this high-priced market in 1938.

Talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1937–38, by uses

Use	1937		1938	
	Short tons	Percent of total	Short tons	Percent of total
Paint	59,660	26	53,506	25
Ceramics	29,793	13	29,590	14
Roofing	23,551	10	27,607	13
Paper	32,127	14	27,329	13
Rubber	26,941	12	25,374	12
Toilet preparations	4,340	2	5,970	3
Foundry facings	3,228	1	2,511	1
Other uses [1]	28,265	12	20,732	10
Use not reported	22,094	10	20,156	9
	229,999	100	212,775	100

[1] Includes crayons, bleaching, insecticides, plaster, textile, and other minor uses.

PRICES

Talc is a relatively low priced commodity. The average value per ton of all grades of talc, pyrophyllite, and ground soapstone, f. o. b. mills, in the last few years, as reported to the Bureau of Mines by producers, has ranged from $10.43 to $12.50 a short ton. In 1938 it was $10.82. Lava-grade talcs and talcs suitable for making crayons bring the highest prices, generally $100 to $150 a ton. Prices for other kinds of domestic talc, pyrophyllite, and ground soapstone are much lower. Domestic ground talcs, except toilet grades, normally range in price from $4 to $20 a ton. Much domestic roofing talc (20- to 50-mesh) is said to have been sold as low as $4 a ton. Quotations on finer-ground domestic talcs, f. o. b. works, carload lots, were about as follows in 1938: Virginia talc, 200-mesh, $4.75 to $5.50, 325-mesh, $6.25 to $7; Georgia talc, 200-mesh, $6, 300-mesh, $7.50 to $10; Vermont talc, 200-mesh, $8 to $14; New York talc, 325-mesh, $11 to $17; California talc, $17 to $20. Ground soapstone from Virginia is generally quoted at $5 to $7 a ton, and that from Vermont at $10 to $12. Ground-pyrophyllite quotations range from $7.50 to $12 a ton. Prices of imported talcs range from $20 or less to $85 a ton, the higher prices being for Italian and French talcs.

Average value per short ton of talc, pyrophyllite, and ground soapstone sold by producers in the United States, 1934–38

1934	$10.46	1937	$11.14
1935	10.70	1938	10.82
1936	10.84		

DEVELOPMENTS IN THE INDUSTRY

Recent plant developments in the pyrophyllite industry include the putting into operation in November 1937 [6] of the new plant of the Carolina Pyrophyllite Co. at Capyco, near Staley, N. C., and reported improvements at the plant of Standard Minerals, Inc., at Hemp, N. C.

The Carolina Pyrophyllite Co. obtains pyrophyllite from its mine, the Gerhardt deposit on Soapstone Mountain, about 4 miles west of the Capyco plant. The mine is operated as a glory hole with a shaft through which the material drops to a haulage tunnel. Trucks carry the pyrophyllite from the mine to the plant, where it is fed to a jaw crusher; the product is ground in Hardinge conical mills, after which it passes to Gayco air separators which can be set to produce any size of material from 60- to 325-mesh.

Inasmuch as the physical properties of pyrophyllite resemble those of ground talc, its early application was as a substitute for ground talc in many industries. In recent years, however, various percentages of pyrophyllite have been used as a ceramic-body ingredient in wall tile, in tableware, and as an addition in electrical porcelains. Stevens [7] has described its use as an electrical insulator and reports as follows:

> Pyrophyllite bodies compare favorably with porcelain in mechanical and electrical characteristics and may be used in applications where high puncture values or zero porosity are not prerequisites. Pyrophyllite is superior to porcelain in high-frequency applications, but it is inferior to steatite.

Parmelee and Barrett [8] have tested the pyrochemical properties of samples of North Carolina and Austrian pyrophyllite. Lintz [9] has discussed the use of talc and pyrophyllite in vitreous and semivitreous dinnerware bodies and concludes that a semivitreous dinnerware body can be developed by use of talc and pyrophyllite with a small percentage of whiting, the body having good drying and firing properties, high mechanical strength, and improved resistance to delayed crazing.

The use of pyrophyllite and talc as mineral fillers was discussed during the year in an article by Maynard.[10]

Investigations of the use of talc as a ceramic material still continue. Two papers by Thurnauer [11] discuss its use as a raw material for the manufacture of high-frequency insulators. In another paper Thurnauer [12] discusses the properties of cordierite-containing ceramic bodies with low thermal expansion, resulting from the firing of talc-kaolin mixtures.

FOREIGN TRADE [13]

Imports.—Both the quantity and value of total imports of talc, steatite or soapstone, and French chalk declined in 1938. The quantity was less than in any year since 1934, and the value was less than

[6] Trauffer, W. E., Pyrophyllite Mining Undergoes Revival: Pit and Quarry, vol. 31, No. 10, April 1939, pp. 42–43.

[7] Stevens, Frank J. (engineering vice president, American Lava Corporation), Notes on the Use of Pyrophyllite as an Electrical Insulator: Jour. Am. Ceram. Soc., vol. 21, No. 9, September 1938, pp. 330–331.

[8] Parmelee, C. W., and Barrett, L. R., Some Pyrochemical Properties of Pyrophyllite: Jour. Am. Ceram. Soc., vol. 21, No. 11, November 1938, pp. 388–393.

[9] Lintz, E. H., The Use of Talc and Pyrophyllite in Semivitreous Dinnerware Bodies: Jour. Am. Ceram. Soc., vol. 21, No. 6, June 1938, pp. 229–237.

[10] Maynard, Poole, The Fillers—Clay, Talc, etc., 1918–38: Chem. Ind., vol. 43, No. 6., November 1938, pp. 491–495.

[11] Thurnauer, Hans (engineer, American Lava Corporation), Notes on Steatite-type, High-frequency Insulation: QST, November 1937, 2 pp.; Review of Ceramic Materials for High-frequency Insulation: Jour. Amer. Ceram. Soc., vol. 20, No. 11, November 1937, pp. 368–372.

[12] Thurnauer, Hans (engineer, American Lava Corporation), Cordierite Gives Low Expansion in Ceramic Bodies: Ceram. Ind., November 1937, 2 pp.

[13] 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.

any year since the bottom of the depression in 1932. Declines were noted in imports from nearly all countries. Italy was again the leading source of supply, with Canada second and France third. Several tons of pyrophyllite were imported in 1938 from Manuels, Conception Bay, Newfoundland. In 1904 and 1905 a total of 7,750 tons were shipped from this deposit to the United States.

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1934–38

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
1934	204	$4,729	20,245	$421,640	20,449	$426,369
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

Talc, steatite or soapstone, and French chalk imported for consumption in the United States, 1937–38, by countries

Country	1937		1938	
	Short tons	Value	Short tons	Value
Argentina	(1)	$15		
Austria	1	69	[2] 1	[2] $69
Belgium			1	60
Canada	7,221	72,388	6,438	65,968
China	2,460	55,357	1,767	42,479
Egypt	92	1,653	55	1,039
France	6,372	102,592	4,244	64,693
Germany	76	898		
Hong Kong	2	456	2	306
India, British	224	3,365	287	4,514
Italy	8,653	208,488	7,842	192,146
Japan	1,364	21,622	1,325	16,915
Kwantung	51	396	34	330
Norway	246	2,623	131	2,647
Sweden			(1)	26
Union of South Africa	26	625		
United Kingdom	88	2,272	(1)	6
	26,876	472,819	22,127	391,198

[1] Less than 1 ton.
[2] Figures cover period Jan. 1 to May 5.

Exports.—Both the quantity and value of exports of "talc, steatite, and soapstone, crude and ground," were less in 1938 than in 1937, a reversal of the upward trend from 1933 to 1937, but the value of exports of "powders—talcum (in packages), face, and compact" was slightly greater than in 1937, continuing the upward trend started in 1934 for this type of material.

Talcum and other powders exported from the United States, 1934–38

Year	Description	Short tons	Value
1934	Talc, crude, in bulk	4,903	$83,530
	Powders—talcum (in packages), face, and compact	(1)	598,404
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

[1] Quantity not recorded.

WORLD PRODUCTION

In 1938, as in previous years, the United States was the leading talc-producing country of the world, its production far exceeding that of other important producing countries, such as Canada in North America, China, and British India in Asia, and Austria, France, Germany, Italy, and Norway in Europe.

World production of talc and soapstone, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
Argentina		176	177	(2)	(2)
Australia:					
New South Wales	341	511	520	526	(2)
South Australia	1,419	954	1,003	991	(2)
Tasmania	6		3		(2)
Bulgaria	15	15			(2)
Canada [3]	12,663	12,522	13,161	11,301	9,846
China (including Manchuria)	68,000	(2)	(2)	(2)	(2)
Egypt	2,603	366	351	2,266	(2)
Finland	1,586	2,185	1,683	881	(2)
France	68,900	59,500	51,550	56,300	(2)
Germany:					
Austria (exports)	20,673	20,951	19,975	14,089	5,625
Bavaria	6,934	7,163	9,589	7,790	(2)
Greece	118	552	864	1,838	(2)
India, British	9,525	12,798	10,128	13,249	(2)
Indochina			630	428	(2)
Italy	37,640	41,692	43,938	45,714	(2)
Morocco, French (exports)	788	720	1,368	841	(2)
Norway	27,723	27,782	29,714	24,701	(2)
Rumania	1,933	1,999	2,529	1,976	(2)
Spain	5,285	(2)	(2)	(2)	(2)
Sweden	6,501	6,063	7,146	7,937	(2)
Union of South Africa (Transvaal)	239	303	413	376	1,519
United States [4]	125,649	156,685	196,124	208,650	193,025
Uruguay (exports)	879	1,200	772	302	1,615

[1] In addition to the countries listed talc is produced in Brazil, Newfoundland, 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: 1934, $44,297; 1935, $32,053; 1936, $32,770; 1937, $40,513; 1938, $35,038. 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

The year 1938, in vivid contrast to the statistical record for 1937, was one of sharply reduced demand for fluorspar. Consequently, production schedules at most domestic mines were suspended or curtailed, and imports declined substantially. Compared with 1937, consumption of fluorspar in 1938 decreased 41 percent, production 46 percent, shipments from domestic mines 56 percent, and imports 47 percent. Domestic shipments were the lowest since 1933 and imports the smallest since 1935.

In spite of the curtailment in fluorspar mining, considerable prospecting and development work were done, several new mines came into production, new milling plants were under construction or completed at three properties, and improvements were made at other mills.

Total sales of fluorspar to consumers in the United States were 99,478 short tons in 1938 (79,615 tons from domestic mines and 19,863 tons from foreign sources) compared with 215,744 tons in 1937 (180,744 tons from domestic mines and 34,970 from foreign sources). Total sales to the steel industry decreased to 62,196 tons in 1938 (161,306 tons in 1937), while sales to manufacturers of hydrofluoric acid declined to 20,976 tons (27,779 tons in 1937) and those to makers of glass and enamel dropped to 12,902 tons (19,507 tons in 1937).

Despite the lessened demand for fluorspar in 1938 the average composite selling price of all grades of fluorspar (both domestic and foreign) delivered to consumers in the United States was virtually the same as in 1937. The average selling price f. o. b. Illinois-Kentucky mines of fluorspar shipped to steel plants was $18 a short ton ($18.89 in 1937) and that of fluorspar shipped to manufacturers of hydrofluoric acid was $25.29 ($27.49 in 1937). The average selling price of imported fluorspar shipped to steel plants was $20.56 a ton at seaboard (duty paid) in 1938 ($22.04 in 1937) and that of fluorspar shipped to manufacturers of hydrofluoric acid was $27.54 a ton ($26.60 in 1937).

Under the Anglo-American trade treaty, the duty on fluorspar containing more than 97 percent calcium fluoride was decreased from $5 a short ton to $3.75 a ton, effective January 1, 1939.

Salient statistics of the fluorspar industry in the United States, 1937–38

	1937		1938	
	Short tons	Value	Short tons	Value
Domestic shipments:				
Gravel	148,846	$2,799,337	59,199	$1,065,960
Lump	13,461	352,315	7,907	182,860
Ground	18,923	514,977	13,297	350,846
	181,230	3,666,629	80,403	1,599,666
Stocks at mines or shipping points Dec. 31:				
Ready-to-ship	30,539	(1)	34,877	(1)
Crude	23,114	(1)	47,802	(1)
	53,653	(1)	82,679	(1)
Imports for consumption:				
Containing more than 97 percent CaF_2	10,248	162,145	9,216	192,469
Containing not more than 97 percent CaF_2	26,815	235,482	10,406	95,174
	37,063	397,627	19,622	287,643
Exports	456	9,091	788	9,061
Consumption (by industries):				
Metallurgical	152,100	(1)	81,400	(1)
Ceramic	18,100	(1)	14,800	(1)
Chemical	24,100	(1)	18,900	(1)
	194,300	(1)	115,100	(1)
Stocks at consumers' plants Dec. 31:				
Metallurgical	75,000	(1)	57,800	(1)
Ceramic	5,200	(1)	2,800	(1)
Chemical	9,900	(1)	11,200	(1)
	90,100	(1)	71,800	(1)

[1] Figures not available.

Other important developments in 1938 were the initial importation of fluorspar from Mexico; first shipments of concentrates from the new flotation mill at Lordsburg, N. Mex.; exports of 541 tons to Japan; beginning of construction of flotation plants at Rosiclare, Ill., and Salida, Colo.; initial shipments by river and rail of fluorspar from Illinois to Atlantic coast consumers; and reduction of 23 percent in stocks of fluorspar at steel plants.

Production and shipments.—Fluorspar was known to have been produced in 1938 at 97 mines and prospects, and small quantities were recovered at an undetermined number of other prospects and reclaimed from mill ponds, waste dumps, and old workings of abandoned mines. All operations yielded about 99,000 short tons of merchantable fluorspar compared with about 183,000 tons in 1937. However, in spite of the large number of properties worked in 1938, 29 mines produced 88 percent of the total output.

Shipments of fluorspar from domestic mines in 1938 aggregated 80,403 short tons valued at $1,599,666, decreases of 56 percent in both quantity and total value from 1937. Shipments in 1938 were equivalent to 64 percent of the average annual tonnages shipped in the 5-year period 1926–30. Of the 1938 shipments, 20,862 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 47,300 tons in 1937.

In 1938, mines operated by or for consumers shipped 13,226 short tons of fluorspar for use in their own plants compared with 31,700 tons in 1937.

The average value of all grades of domestic fluorspar shipped was \$19.90 a ton (\$0.33 less than the 1937 average). The value recorded for domestic fluorspar is the price paid f. o. b. mine shipping point and excludes cost of containers.

In 1938, 5 ounces of optical fluorspar were sold for \$5.

The following table gives details of shipments of fluorspar by States for 1938 that may be published without revealing, except by permission, operations of individual producers.

Fluorspar shipped from mines in the United States in 1938, by States

State	Gravel [1]			Lump		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Illinois	26,324	\$507,620	\$19.28	4,203	\$164,245	\$23.86
Kentucky	27,520	492,692	17.90	2,680		
New Mexico	765			---------	---------	---------
Arizona	668	40,169	11.94	---------	---------	---------
Nevada	1,930			852		
Colorado	1,569			135	18,615	18.18
Utah	333	25,479	12.79	37		
New Hampshire	90			---------	---------	---------
Total: 1938	59,199	1,065,960	18.01	7,907	182,860	23.13
1937	148,846	2,799,337	18.81	13,461	352,315	26.17

State	Ground [2]			Total		
	Short tons	Value		Short tons	Value	
		Total	Average		Total	Average
Illinois	4,841			35,368	\$751,227	\$21.24
Kentucky	4,603			34,803	678,094	19.48
New Mexico	3,301	\$350,846	\$26.39	4,066		
Arizona	425			1,093	142,802	17.70
Nevada	127			2,909		
Colorado	---------	---------	---------	1,704		
Utah	---------	---------	---------	370	27,543	12.73
New Hampshire	---------	---------	---------	90		
Total: 1938	13,297	350,846	26.39	80,403	1,599,666	19.90
1937	18,923	514,977	27.21	181,230	3,666,629	20.23

[1] Includes flotation concentrates shipped for use in making hydrofluoric acid and cement and run-of-mine fluorspar for use as flux in steel plants.
[2] Includes flotation concentrates shipped to the glass and enamel trades.

The following table shows domestic shipments, imports, exports, and consumption in the United States for the past 5 years.

Domestic shipments, imports, exports, and consumption of fluorspar in the United States, 1934–38

Year	Domestic shipments		Imports for consumption		Exports		Consumption
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons
1934	85,786	\$1,391,405	16,705	\$183,286	522	\$8,602	110,600
1935	123,741	1,860,638	16,340	179,049	313	4,651	137,400
1936	176,877	3,119,668	25,504	256,262	240	4,079	182,400
1937	181,230	3,666,629	37,063	397,627	456	9,091	194,300
1938	80,403	1,599,666	19,622	287,643	788	9,061	115,100

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, 1937–38, by uses

Use	1937				1938			
	Quantity		Value		Quantity		Value	
	Percent of total	Short tons	Total	Average	Percent of total	Short tons	Total	Average
Steel	75.62	137,040	$2,536,074	$18.51	64.67	51,991	$912,111	$17.54
Foundry	1.42	2,566	47,264	18.42	2.54	2,041	33,755	16.54
Glass	7.01	12,697	340,187	26.79	10.82	8,702	224,315	25.78
Enamel	3.34	6,054	166,186	27.45	5.10	4,100	109,165	26.63
Hydrofluoric acid	9.86	17,879	481,544	26.93	14.28	11,484	285,274	24.84
Miscellaneous	2.50	4,538	86,283	19.01	1.61	1,297	25,985	20.03
	99.75	180,774	3,657,538	20.23	99.02	79,615	1,590,605	19.98
Exported	.25	456	9,091	19.94	.98	788	9,061	11.50
	100.00	181,230	3,666,629	20.23	100.00	80,403	1,599,666	19.90

Consumption and consumers' stocks.—The following tables give data on consumption and stocks of fluorspar.

Fluorspar consumed and in stock in the United States, 1937–38, by industries, in short tons

[Partly estimated by Bureau of Mines]

Industry	1937		1938	
	Consumption	Stocks at consumers' plants Dec. 31	Consumption	Stocks at consumers' plants Dec. 31
Basic open-hearth steel	138,900	71,400	73,600	55,000
Electric furnace steel	7,500	1,300	4,000	1,000
Foundry	2,500	800	2,000	800
Ferro-alloys	1,200	700	800	400
Hydrofluoric acid	24,100	9,900	18,900	11,200
Enamel	5,900	1,500	4,000	900
Glass	11,600	3,200	10,500	1,600
Miscellaneous	2,600	1,300	1,300	900
	194,300	90,100	115,100	71,800

Consumption and stocks of fluorspar at basic open-hearth steel plants, 1934–38

	1934	1935	1936	1937	1938
Production of basic open-hearth steel ingots and castings long tons	23,440,000	30,447,000	43,615,000	46,361,000	25,868,000
Consumption of fluorspar in basic open-hearth steel production short tons	81,000	99,600	133,900	138,900	73,600
Consumption of fluorspar per ton of steel made pounds	6.9	6.5	6.1	6.0	5.7
Stocks of fluorspar on hand at steel plants at end of year short tons	45,500	47,500	59,200	71,400	55,000

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 and dropped to 5.69 pounds in 1938 from 5.99 pounds in

1937. It is noteworthy that since 1921, the first year for which data were collected, the average consumption of fluorspar per ton of basic open-hearth steel made has declined almost steadily from 8.2 to 5.7 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 per ton of steel, 1934–38, in pounds

1934	1935	1936	1937	1938	1934	1935	1936	1937	1938
14.443	13.243	13.187	13.867	12.548	7.488	7.048	6.734	7.360	8.420
4.766	4.182	4.792	5.623	4.457	6.584	9.347	10.495	6.623	11.984
5.141	4.803	4.541	4.376	3.845	9.820	8.168	5.104	4.358	3.831
9.958	8.452	10.519	8.795	8.297	5.900	5.236	5.027	6.619	6.448
6.195	7.027	4.105	3.550	6.843	6.429	6.764	6.357	8.895	8.340
5.768	5.658	5.160	5.275	3.694	6.780	5.257	5.917	5.236	6.195
5.046	6.857	7.416	6.404	6.806	7.547	7.115	6.789	6.816	6.097

Quoted prices.—In 1938 the quoted price f. o. b. Illinois-Kentucky mines for fluxing gravel fluorspar was $20 a short ton for rail delivery and $22 for barge delivery at Ohio River landings. Imported fluxing gravel fluorspar (at seaboard, duty paid) was quoted at $23.50 to $24 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 1938 was 82,679 short tons, or about 54 percent more than in 1937. These stocks comprised about 47,800 tons of crude fluorspar (calculated to be equivalent to 28,000 tons of ready-to-ship fluorspar) and 34,877 tons of ready-to-ship fluorspar.

Stocks of fluorspar at mines or shipping points in the United States, Dec. 31, 1937 and 1938, by States, in short tons

State	1937			1938		
	Crude [1]	Ready-to-ship	Total	Crude [1]	Ready-to-ship	Total
California	50		50	50		50
Colorado	260		260	260		260
Illinois	18,466	10,132	28,598	35,157	10,182	45,339
Kentucky	3,926	20,325	24,251	12,207	24,486	36,693
Nevada	75		75			
New Hampshire	157	17	174			
New Mexico	132	65	197	20	209	229
Texas	48		48	48		48
Utah				60		60
	23,114	30,539	53,653	47,802	34,877	82,679

[1] The greater part of this crude (run-of-mine) fluorspar must be beneficiated before it can be marketed.

Technologic developments.—Commercial flotation of fluorspar in the United States is now about 10 years old; the process was first used commercially at Rosiclare, Ill., on March 18, 1929. Since that time plants have been completed and operated at Deming, Arrey, and Lordsburg, N. Mex., and Boulder, Colo. The mill at Boulder discontinued operations on fluorspar in 1937. Additional plants are under construction at Salida, Colo., and Rosiclare, Ill. Total output of flotation concentrates from 1929 through 1938 was 50,552 short tons.

Mitchell, Gross, and Oehler [1] have reviewed briefly the work of other investigators on froth flotation of fluorspar and have presented the results of their studies, the object of which was to determine some of the fundmental froth flotation properties of fluorspar and the associated gangue minerals, quartz and calcite. These investigators summarize their findings as follows:

A sample of table tailings from a fluorspar mill, containing a high percentage of calcite, was analyzed for particle size and mineral content. The minus 48-mesh portion was then used to study some of the froth flotation properties of fluorite and associated gangue minerals, quartz and calcite.

The best concentrates and the highest recoveries were obtained with cell temperatures of from 60° to 90° C.

The amount of reagents and the pH of the ore pulp were found to have pronounced effects on the recoveries obtained. About 1 pound of sodium carbonate per ton of ore proved to be the optimum amount. The best pH was 8.5. Water glass of 1.40 sp. gr. was used to the extent of 0.12 lb. per ton of ore. The consumption of fatty acid depended somewhat upon the amounts of other reagents used; too much fatty acid lowered the grade of concentrate.

Tap water proved to be fully as satisfactory as distilled water in these tests. Stearic acid was used as a collector in one run and gave results similar to those obtained with oleic acid.

Generally speaking, the smaller sizes were more easily floated. Fluorite coarser than 65-mesh was difficult to float. The best selectivity indices were obtained with material between 65- and 150-mesh in size.

Clemmer and others [2] have recorded observations and data obtained in applying selective flotation to several ores from the Cave in Rock (Ill.) district. Both batch and continuous tests are given to show the application of flotation to the production of lead, zinc, and fluorspar concentrates. Approximately 85 tons of fluorspar were collected during these plant tests. Of this amount, 38 tons averaged 98.01 percent CaF_2 and 47 tons averaged 95.22 percent CaF_2. According to these investigators:

The results of laboratory batch and pilot-plant tests, followed by larger-scale tests, have successfully demonstrated the feasibility of flotation for the concentration of southern Illinois lead-zinc-fluorspar ores. Although much work remains to be done before the ultimate metallurgical practice is established, the tests have shown that acceptable lead, zinc, and fluorspar concentrates may be produced with satisfactory recoveries.

If the middlings are to be marketed as metallurgical fluorspar, agglomeration such as briquetting or sintering probably will be necessary to make the product acceptable to steel makers. In fact, experiments on sintering fluorspar were conducted in 1938 by the Mahoning Mining Co., which reported that results of laboratory work and of a large-scale test on 150 tons were quite satisfactory, both from the standpoint of performing the sintering operation and of use of the product by an open-hearth steel maker.

Some results of studies by the Bureau of Mines on lead-zinc-fluorspar middlings from Mexico, Ky., and Cave in Rock, Ill., and on fluorspar concentrates from Wilmore, Ky., are given in a recent report.[3]

A method of removing fluorspar from zinc concentrates is the subject of United States Patent 2137600, dated November 22, 1938.

A few tests of a new electrostatic process for the separation of fluorspar and associated minerals were made during 1938.

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[1] Mitchell, D. R., Gross, H. E., and Oehler, H. E., Froth Flotation of Fluorspar: Am. Inst. Min. and Met. Eng. Tech. Pub. 999, November 1938, 13 pp.

[2] Clemmer, J. B., Duncan, W. E., DeVaney, F. D., and Guggenheim, M., Flotation of Southern Illinois Lead-Zinc-Fluorspar Ores: Progress Reports—Metallurgical Division. 31. Ore-Dressing Studies: Bureau of Mines Rept. of Investigations 3437, 1939, 31 pp.

[3] Dean, R. S., and others, Progress Reports—Metallurgical Division. 27. Ore-Testing Studies, 1937-38: Bureau of Mines Rept. of Investigations 3425, 1938, pp. 97-99.

INDUSTRY IN 1938, BY STATES

Arizona.—Shipments of fluorspar from Arizona were 1,093 short tons in 1938 compared with 610 tons in 1937. Production in 1938 came from the Polly Ann and Daniel Camp mines, near Duncan, Greenlee County. Most of the fluorspar from the Polly Ann mine was shipped to domestic steel plants and to Japan. The fluorspar from the Daniel Camp mine and some from the Polly Ann mine moved to the flotation plants at Deming and Lordsburg, N. Mex. The flotation concentrates recovered from the fluorspar, instead of the run-of-mine material produced, have been credited to Arizona in the statistics.

California.—A plant for grinding fluorspar for the ceramic trade was constructed at West Berkeley the latter part of 1938.

Colorado.—Shipments of fluorspar from Colorado were 1,704 short tons in 1938 compared with 7,883 tons in 1937. Of the 1938 shipments, 1,465 tons went to steel plants, 135 tons to iron foundries, 44 tons to ferro-alloy plants, and 60 tons to hydrofluoric-acid plants. Shipments in 1938 comprised 104 tons from Boulder County and 1,600 tons from Chaffee County.

A mill comprising jigs and flotation machines was reported under construction by the Colorado Fluorspar Corporation, Salida, Colo.

Illinois.—Approximately 75,000 short tons of fluorspar-bearing rock, equivalent to 46,000 tons of merchantable fluorspar, were mined at 30 mines or prospects in 1938 compared with about 138,000 tons, equivalent to 81,000 tons of merchantable fluorspar, mined at 26 mines or prospects in 1937. Of the merchantable fluorspar produced in 1938, 38,000 tons were from mines where the fluorspar occurs in veins, chiefly in fault fissures, and 8,000 tons from mines where the fluorspar occurs in flat-lying tabular masses, locally called blanket formations.

Fluorspar-bearing material milled in Illinois in 1938 totaled 59,000 tons, from which 36,000 tons of fluorspar were recovered—a ratio of 1.639 : 1.

Shipments from Illinois were 35,368 tons in 1938 compared with 78,664 tons in 1937. Of the total, 13,572 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 31,552 tons in 1937.

The Argo, Blue Diggings, Crystal, Daisy, Good Hope, Hamp, Hillside, Lee, and Spar Mountain mines supplied about 89 percent of the total merchantable fluorspar produced in Illinois in 1938. Most of the remainder came from the Boundary Shaft, Douglas, Humm, Lead Hill, Stewart, and Victory mines.

Development work at the Daisy mine in 1938 consisted of drifting 150 feet on the 800-foot level of the Daisy vein and driving a crosscut from the Daisy vein to the Blue Diggings vein which encountered 5 feet of good fluorspar. It was believed that the crosscut would show that the Daisy and Blue Diggings veins intersected at the 800-foot level. However, according to A. H. Cronk, the junction of the two veins has not yet been determined; in fact, the Blue Diggings vein shows indications of straightening, which would make the two veins meet below the 800-foot level. A considerable tonnage of acid-grade fluorspar was produced directly from the stopes on the Blue Diggings vein.

The Rosiclare Lead & Fluorspar Mining Co. made important additions to its power plant at Rosiclare. A new steel, brick, and concrete building was completed to house a 1,250-kilowatt and a 1,000-kilowatt turbine generator and two 600-horsepower boilers. Water for condensing purposes in the turbo-generators will be pumped directly from the Rosiclare mine by a 3,000-gallon-per-minute pump which has been installed in the Rosiclare shaft. The water in the Rosiclare mine will be lowered to approximately the 250-foot elevation, which will permit mining above this level on the Rosiclare vein. The Rosiclare mine has been inactive since January 1924, when it was flooded.

The Mahoning Mining Co. continued prospecting and development at its property about 8 miles north of Cave in Rock. Up to April 15, 1939, 125 churn-drill holes, 300 to 400 feet deep, had been put down and 2 shafts sunk. According to A. G. Johnson, mineralization in the new area now being developed does not appear to be as widespread as that in the section to the southwest near the escarpment. However, 3 bedded deposits have been located in an area about 1 mile square. One ore body occurs in the Fredonia limestone at the base of the Rosiclare sandstone, 1 in the Renault limestone at the base of the Bethel sandstone and 100 feet above the base of the Rosiclare sandstone, and 1 at the sub-Rosiclare horizon 50 to 60 feet below the base of the Rosiclare sandstone. Because of the prevailing dip (about 5°) of the formations to the northeast, the ore bodies lie much deeper than those to the southwest, but their fluorspar content is not as high. In addition to fluorspar, appreciable quantities of zinc, lead, and secondary quartz as well as smaller quantities of barite occur in the ore bodies, all more or less finely disseminated throughout the mass. In the ore body in the sub-Rosiclare horizon the lead-zinc content of the ore is high enough to be of economic importance. In the other 2 ore bodies it appears to be too low. The ore body in the sub-Rosiclare horizon has now been developed by a 300-foot shaft and several hundred feet of crosscutting. The ore body in the Renault limestone has been developed by a 160-foot shaft and 200 feet of drifting.

The Mahoning Mining Co. started construction at Rosiclare of a milling plant designed to treat 200 tons of lead-zinc-fluorspar ore in 24 hours; it is planned to have it in operation in May 1939. The plant will comprise a jaw crusher, a cone crusher, a vibrating screen, a ball mill, and three banks of flotation machines, one each for lead, zinc, and fluorspar. The fluorspar concentrates will be filtered and dried in a department separate from the flotation unit. Power for the plant will be supplied by the Rosiclare Lead & Fluorspar Mining Co. The crude ore will be trucked from the mine to the mill.

At the Victory mine 3,984 feet of diamond-core drilling was done in 1938.

At the Blue Diggings mine on the Blue Diggings vein, where the shaft was sunk from 538 to 720 feet in 1937, the 600- and 700-foot levels were driven north 160 and 600 feet, respectively, in a vein of fluorspar averaging 3 feet in width.

The 500-foot level of the Argo mine was driven north 380 feet and south 400 feet from the Blue Diggings-Argo crosscut. The vein of fluorspar in the north drift averaged 3 feet in width. The vein in the south drift started at a width of 2 feet but pinched out a short distance from the crosscut. The drift was continued, and at slightly more than 200 feet from the crosscut a 2-foot vein was found which at 250 feet widened to 5 feet. At this point the drift broke through into a cavern 40 feet along the vein, 40 feet wide, and 90 feet high. The entire cavity was lined with marcasite studded with calcite crystals. The drift was continued along the east wall of the cavern in a 5-foot vein of fluorspar.

A new shaft 100 feet deep was sunk on the East-West vein at the Hamp mine. The 100-foot level was driven west 80 feet in low-grade ore. From this point a winze was sunk 60 feet in good fluorspar and a level driven west 100 feet.

Substantial improvements were made in the flotation mill of the Aluminum Ore Co. at Rosiclare.

Some development work was done at the Cave in Rock, Hardin Minerals, Jackson, Lacey, Pell, and Preen properties.

Kentucky.—Production of merchantable fluorspar in Kentucky was about 43,000 short tons in 1938 compared with 87,000 tons in 1937, and shipments were 34,803 tons compared with 87,296 tons in 1937. Of the 1938 shipments, 7,290 tons were shipped by barge for delivery at upper Ohio River and tributary landings compared with 15,748 tons in 1937.

Virtually the entire output of fluorspar in Caldwell County in 1938 came from the Hollowell & Hobby mine, near Princeton.

Production in Crittenden County, amounting to approximately 15,000 tons, came chiefly from the Bachelor, Beard, Butler, Davenport, Hodge, Keystone, Lafayette, Memphis, Pigmy, and Susie Beeler mines, which contributed about 85 percent of the output of Crittenden County. Production was 49,000 tons in 1937.

In Livingston County about 24,000 tons of merchantable fluorspar were produced in 1938 compared with 35,000 tons in 1937. The chief producing mines were the C. R. Babb, Klondike, and Nancy Hanks mines, which accounted for 93 percent of the output of Livingston County.

In 1938 the Faircloth mine near Wilmore, Woodford County, shipped 300 tons of fluxing-gravel and 150 tons of acid lump fluorspar, and the Twin Chimney mine near Mundys Landing, Mercer County, shipped 150 tons of fluxing-gravel fluorspar.

Montana.—The Boeing prospect near Austin, Lewis and Clark County, was being developed in 1938.

Nevada.—Shipments of fluorspar from Nevada were 2,909 short tons in 1938 compared with 2,544 tons in 1937. Of the 1938 shipments, 1,881 tons went to steel plants, 292 tons to glass and enamel makers, 686 tons to hydrofluoric-acid manufacturers, and 50 tons to cement plants.

The chief producing mine in Nevada in 1938 was the Baxter, in Mineral County, which shipped 2,142 tons. The other active mine was the Daisy, in Nye County, which shipped 767 tons, including 127 tons of ground fluorspar.

New Hampshire.—Fluorspar activity at the Stoddard mine near Westmoreland, Cheshire County, in 1938 was confined to milling some ore previously mined and to shipping 78 tons to steel plants and 12 tons to foundries.

New Mexico.—Shipments of fluorspar from New Mexico were 4,066 short tons in 1938 compared with 3,324 tons in 1937 and comprised

3,464 tons of high-grade flotation concentrates and 602 tons of metallurgical-grade fluorspar.

Production came chiefly from the Sadler mine in Luna County; Big Spar mine in Catron County; White Eagle, Shrine, Bitter Creek, and Rain Creek mines in Grant County; "Dean" mine in Hidalgo County; Lyda K mine in Sierra County; and Mallery mine in Valencia County.

Initial shipments of concentrates were made from the new flotation mill at Lordsburg.

The General Chemical Co., a large consumer of acid-grade fluorspar, acquired the flotation plant of the La Purisima Fluorspar Co. in October 1938; the mill capacity has been tripled.

Utah.—Shipments of fluorspar from Utah were 370 short tons in 1938 compared with 431 tons in 1937. Virtually all shipments in 1938 came from the Monarch claims in Beaver County; a little came from Tooele County. Of the 1938 shipments, 295 tons went to steel plants, 37 tons to foundries, and 38 tons to Japan.

At the Dalton property, also in Beaver County, development work was continued, in the course of which a small quantity of fluorspar was mined; a mill, consisting of rolls, a trommel screen, and a four-cell jig, was completed.

A small quantity of fluorspar was mined (but not shipped) at the Utah Fluorspar Co. property, also in Beaver County.

OPTICAL FLUORSPAR

Optical fluorspar, which is rather rare and difficult to obtain, has been found occasionally in mines in the Illinois-Kentucky district, in the Central Kentucky district, and in some Western States, chiefly California. Although there is a limited market for flawless, transparent crystals of fluorspar, apparently the demand is only partly supplied from domestic sources. In 1938, for example, only 5 ounces of optical fluorspar valued at $5 were reported sold by domestic producers.

Lithium fluoride crystals, now made commercially in the United States, are reported to make an excellent substitute for optical fluorite.[4] These crystals are said to have optical characteristics similar to fluorite and to show transparency considerably farther in the ultraviolet.

IMPORTS AND EXPORTS [5]

Imports of fluorspar for consumption in the United States in 1938 totaled 19,622 short tons (9,216 tons containing more than 97 percent and 10,406 tons containing not more than 97 percent calcium fluoride) valued [6] at $287,643, compared with 37,063 tons (10,248 tons containing more than 97 percent and 26,815 tons containing not more than 97 percent calcium fluoride) valued [6] at $397,627 in 1937. The value assigned to the foreign fluorspar in 1938 averaged $14.66 a ton. The cost to consumers in the United States also includes duty, loading

[4] Industrial and Engineering Chemistry, News Ed., vol. 16, No. 21, Nov. 10, 1938, p. 584.

[5] 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.

[6] As defined in sec. 402 of the tariff act of 1930, "The value of imported merchandise * * * is the foreign value or the export value, whichever is higher—that is, the market value or the price at which the merchandise, at the time of exportation to the United States, is offered for sale in the principal markets of the country from which exported, including the cost of containers or coverings and all expenses (including any export tax) incident to placing the merchandise in condition ready for shipment to the United States."

charges at the docks, ocean freight, insurance, consular fee, and freight from docks to consuming points. The duty on fluorspar containing more than 97 percent calcium fluoride was decreased from $5 a short ton to $3.75 a ton, effective January 1, 1939. The duty on fluorspar containing not more than 97 percent calcium fluoride remained $7.50 a short ton.

Of the 1938 imports, 52.8 percent was metallurgical gravel fluorspar, 0.5 percent ceramic ground fluorspar, and 46.7 percent acid lump fluorspar. The metallurgical gravel fluorspar was imported from France, Newfoundland, Spain, Tunisia, and the United Kingdom; the ceramic ground fluorspar from France and Germany; and the acid lump fluorspar from Germany, Mexico, Newfoundland, Tunisia, and the Union of South Africa. Imports were equivalent to 24 percent of the total shipments of domestic fluorspar in 1938 compared with 20 percent in 1937.

Fluorspar imported for consumption in the United States in 1938, 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			1,221	$12,923	1,221	$12,923
Maryland			3,776	23,341	3,776	23,341
New York	22	$591			22	591
Philadelphia	17	333	2,375	29,909	2,392	30,242
	39	924	7,372	66,173	7,411	67,097
Germany:						
Los Angeles	17	411			17	411
Philadelphia	3,045	50,893			3,045	50,893
	3,062	51,304			3,062	51,304
Mexico: New York	85	1,263			85	1,263
Newfoundland:						
Buffalo			1,344	16,292	1,344	16,292
New York	(1)	9	18	274	18	283
Philadelphia	3,390	87,334			3,390	87,334
	3,390	87,343	1,362	16,566	4,752	103,909
Spain: Philadelphia			309	3,535	309	3,535
Tunisia: Philadelphia	853	13,588	719	4,663	1,572	18,251
Union of South Africa:						
Maryland	241	5,007			241	5,007
New York	847	17,902			847	17,902
Philadelphia	699	15,138			699	15,138
	1,787	38,047			1,787	38,047
United Kingdom: Philadelphia			644	4,237	644	4,237
Total: 1938	9,216	192,469	10,406	95,174	19,622	287,643
1937	10,248	162,145	26,815	235,482	37,063	397,627

[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 1937 and 1938 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 1937 and 1938. The quantities in the following table are based on 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 1,165 short tons at the close of 1938.

Imported fluorspar delivered to consumers in the United States, 1937–38

Industry	1937			1938		
	Short tons	Selling price at tidewater, including duty		Short tons	Selling price at tidewater, including duty	
		Total	Average		Total	Average
Steel	24,266	$534,826	$22.04	10,205	$209,801	$20.56
Glass	166	6,205	37.38	11	418	38.00
Enamel	590	21,885	37.09	89	2,254	25.33
Hydrofluoric acid	9,900	263,336	26.60	9,492	261,399	27.54
Cement	48	1,073	22.35			
Miscellaneous				66	1,546	23.42
	34,970	827,325	23.66	19,863	475,418	23.93

Producers of fluorspar reported exports of 788 short tons valued at $9,061 in 1938 compared with 456 tons valued at $9,091 in 1937. Of the 1938 exports, 247 tons went to Canada and 541 tons to Japan.

Fluorspar reported by producers as exported from the United States, 1934–38

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1934	522	$8,602	$16.48	1937	456	$9,091	$19.94
1935	313	4,651	14.86	1938	788	9,061	11.50
1936	240	4,079	17.00				

WORLD PRODUCTION

The following table shows the production of fluorspar by countries from 1934 to 1938, inclusive, insofar as statistics are available. Complete returns for 1938 are not yet available, but except for the U. S. S. R. those for 1937 are nearly complete. If the output of the U. S. S. R. is estimated roughly at 70,000 tons in 1937, world production of about 522,000 metric tons is indicated, of which the United States furnished 32 percent, Germany 28 percent, the U. S. S. R. 13 percent, France 10 percent, and the United Kingdom 8 percent—a total of 91 percent.

World production of fluorspar, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Argentina [1]	311	403	450	(2)	(2)
Australia:					
New South Wales	203	420	339	55	(2)
Queensland	1,328	185	487	1,410	2,479
South Australia	234	91	23	--------	(2)
Canada	136	68	68	136	197
China	5,050	(3)	(3)	(2)	(2)
Chosen	12,099	9,722	8,740	11,000	(2)
France	14,100	22,750	30,600	51,430	(2)
Germany:					
Anhalt	7,357	8,068	11,225	13,662	(2)
Baden	6,527	3,941	7,359	13,637	(2)
Bavaria	29,661	31,277	49,153	62,455	(2)
Prussia	21,555	24,618	36,271	30,514	(2)
Saxony	4,945	6,938	7,990	8,074	(2)
Thuringia	(3)	23,572	18,792	16,117	(2)
Italy	9,668	8,424	11,437	13,385	(2)
Mexico [4]	900	900	900	900	900
Newfoundland (shipments)	2,535	4,082	8,498	8,479	8,944
Norway	673	1,067	1,013	1,093	(2)
South-West Africa	--------	--------	--------	--------	585
Southern Rhodesia	--------	--------	--------	--------	156
Spain	6,365	(3)	(3)	(2)	(2)
Switzerland	[4] 1,000	--------	--------	--------	(2)
Tunisia	--------	--------	--------	1,676	2,060
Union of South Africa	1,578	1,980	3,123	3,615	4,736
U. S. S. R.	27,000	49,100	65,000	(2)	(2)
United Kingdom	34,765	31,646	33,491	42,837	(2)
United States (shipments)	77,823	112,255	160,459	164,408	72,940
	286,000	353,000	465,000	(2)	(2)

[1] Railway shipments.
[2] Data not available.
[3] Data not available; estimate included in total.
[4] Estimated.

France.—The production of fluorspar in France, which reached an all-time peak of 58,660 metric tons in 1930, declined to 14,100 tons in 1934, and many mines were closed permanently. Since 1935 several mines have been reopened, and production has advanced progressively to 51,430 metric tons in 1937, the latest year for which statistics are available. Production undoubtedly declined in 1938, partly because of decreased exports. In 1938, for example, imports of fluorspar into the United States from France were only 7,411 short tons compared with 14,158 tons in 1937.

Production of fluorspar in France, 1930 and 1935–37, by Departments, in metric tons

Department	1930	1935	1936	1937
Ardèche	1,250	--------	--------	--------
Ardennes	160	450	550	150
Aveyron	600	--------	--------	2,530
Haute-Loire	5,700	9,900	13,000	15,710
Indre	800	300	--------	--------
Nièvre	150	--------	--------	--------
Puy-de-Dôme	4,000	3,000	4,950	4,630
Rhône	1,400	--------	2,150	3,510
Saône-et-Loire	17,400	7,400	5,900	9,920
Var	27,200	1,700	4,050	14,980
	58,660	22,750	30,600	51,430

The present status of the French fluorspar industry has been discussed and the chief mines have been described by Chermette.[7]

The following notes pertaining to the Font-Sante, Garrot, and "Luc" mines in the Department of Var, which export to the United States, have been taken from the article by Chermette.

[7] Chermette, A., Le Spath-fluor français en 1938. (French Fluorspar in 1938): Mines, Carrières, vol. 17, No. 193, Paris, November 1938, pp. 1–13.

The Font-Sante mine suspended operations in 1933, after having exported 50,000 tons of fluorspar. In 1935 the mine was reopened and small shipments were made to the United States; in 1936 exports were increased. In 1937 the mine was operated at the rate of 1,200 tons monthly. Several veins are mined, of which one attains an average width of 4 meters (13.1 feet) over a length of 60 meters (197 feet). Fluorspar-bearing rock from the mine is sent to the washery by means of an aerial ropeway 1,800 meters (5,905 feet) long.

The Garrot mine, near the Font-Sante, was formerly active, but operations were suspended in 1932. The mine was reopened in August 1937. Mine equipment has been electrified and a modern washery is to replace the older plant. The equipment will handle a monthly production of 1,000 tons.

In 1937 a new mine at Luc was opened, and a production of 12 tons daily was attained. A washery of 15 tons daily capacity was being constructed.

Germany.—Germany is second only to the United States as a producer of fluorspar but it is the chief exporting country. In 1937, for example, production was 144,459 metric tons; and exports were 46,009 metric tons, of which 12,699 metric tons went to the United States. Fluorspar was produced at 36 mines in 1937—1 in Anhalt, 2 in Baden, 18 in Bavaria, 5 in Prussia, 3 in Saxony, and 7 in Thuringia. Figures on production are not yet available for 1938, but exports decreased to 27,316 metric tons, of which 2,812 metric tons went to the United States. No fluorspar from Germany was received in the United States from August 1938 to March 1939.

Newfoundland.—Shipments of fluorspar from Newfoundland in 1938 were 9,859 short tons, of which 1,404 tons of fluxing grade, 3,548 tons of acid grade, and 15 tons for experimental purposes went to the United States; 2,539 tons of fluxing grade, 1,116 tons of acid grade, and 1,237 tons of special-grade lump (93 to 95 percent CaF_2) went to Canada. Shipments were 9,346 short tons in 1937.

The geological features of the fluorspar deposits of Newfoundland, the veins, and the mining and milling practices have been described by Howse.[8] The paper is accompanied by a mill flow sheet of the St. Lawrence Corporation of Newfoundland, Ltd., and a map showing the fluorspar veins. The veins are described as follows:

> The veins vary in width from 6 inches to 14 feet of solid fluorspar, and in places a width of fluorspar and granite breccia up to 35 feet is to be found. The presence of included granite is often a deciding factor in the economic value of the vein. Up to the present time it has been the practice to mine those veins which have the smallest proportion of granite, as this lowers appreciably the cost of hand picking. The length of the veins, as exposed to date, varies from 7,700 feet in the case of the Blue Beach vein to 200 feet in the case of the smallest known veins of the area. However, it may be said that in no case has a fissure vein been followed along its entire course, or even until it has narrowed beyond the point of economic mining.
>
> The most promising veins known to date are the Black Duck, Iron Springs, Blue Beach, Tarefare, Director, Lord and Lady Gulch, Red Head, Doctor's Pond, Scrape, Hookey, Grassy Gulch, Little Salt Cove, Morris, New Morris and Blake's Brook. It is interesting to note that all the veins strike within 45° southeast and 45° northwest of the general strike of the granite stock.
>
> This vein [Black Duck] is the most extensively worked to date. It has been mined to a depth of 180 feet, and shaft sinking is now in progress to a greater depth. The vein pinches and swells, both horizontally and vertically, from 6 inches to 8 feet. The average width is 4 feet and at the 180-foot level it appears to be quite as strong as it is at the surface. The dip is vertical and the vein has been mined

[8] Howse, C. K., St. Lawrence Fluorspar Mines: Newfoundland Geol. Survey Inf. Circ. 4, 1938, pp. 26–32.

laterally for 450 feet, with no diminution in width laterally. The vein is made up practically of pure fluorite, the only gangue materials being small amounts of sulfides of copper and zinc and granite breccia. This breccia makes up the greatest part of the gangue and usually is easily hand-picked, leaving a very high fluorspar concentrate.

The Iron Springs vein, next to the Black Duck vein, is best developed to date. Sinking has continued from the surface to a depth of 55 feet, and a dam has been erected near its intersection with Salt Cove Brook. The fluorspar in this vein is of higher grade than Black Duck, as there is less included granite breccia. This vein can be mined and shipped, with very little hand picking, as acid-grade ore. It varies in width from 2 feet to 9 feet with very clean walls at all points investigated to date. The vein dips at an angle of 68°, and a shaft is now being sunk to the 100-foot level where drifting east and west will begin. Mining has been done for a distance of 450 feet along strike.

Other veins on which mining has been done by open-cut contract are: The Scrape from which about 300 tons have been extracted, Doctor's Pond from which about 800 tons have been taken, Hare's Ears from which 2,000 tons have been mined, Blue Beach which has been mined on the No. 2 and No. 3 veins, about 1,500 tons having been extracted. Contracting began in December 1936 on the Lord and Lady Gulch and New Morris veins. The fluorspar in these veins is not as high grade as that of the Black Duck and Iron Springs, though "steel grade" can be produced with a little hand picking.

Tunisia.—Production of fluorspar in Tunisia, which was inaugurated in 1937, increased from 1,676 metric tons to 2,060 tons in 1938. Imports into the United States in 1938 comprised 719 short tons of fluxing grade and 853 tons of acid grade.

Union of South Africa.—Production of fluorspar in the Union of South Africa advanced to 5,221 short tons in 1938 from 3,985 tons in 1937, owing chiefly to greatly increased exports to the United States and to demand from Japan.

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.

British Patent 463092 covers improvements in the manufacture and production of synthetic cryolite.

Imports.—The following table shows imports of cryolite into the United States in 1937 and 1938. 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, 1937–38, by countries

Country	1937		1938	
	Long tons	Value	Long tons	Value
Canada	1,328	$154,256		
Denmark	994	159,778		
France	364	53,593	74	$11,579
Germany	2,174	389,817	333	63,027
Greenland	11,826	723,740	11,708	711,000
United Kingdom	4	957		
	16,690	1,482,141	12,115	785,606

[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.

FELDSPAR

By Robert W. Metcalf

SUMMARY OUTLINE

The quantity of feldspar sold or used in the United States dropped sharply in 1938. The tonnage of both crude and ground spar fell far short of the records realized in 1936 and 1937, but remained higher than in 1935 and compared favorably with the best predepression

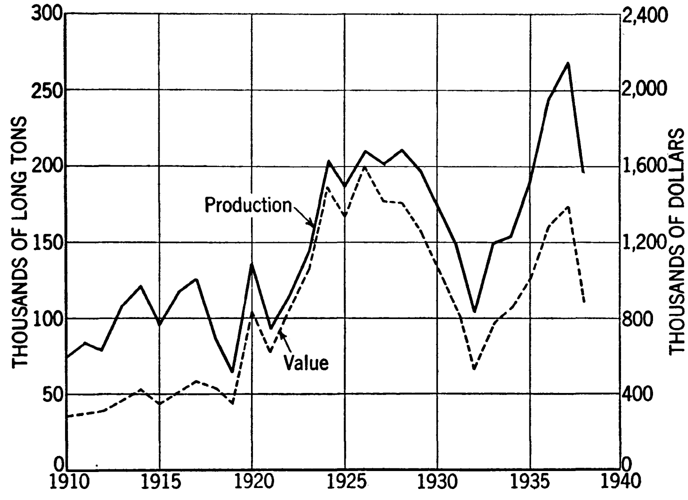

Figure 1.—Trends in production and value of crude feldspar in the United States, 1910–38.

levels. The average value per ton of the national output in 1938, however, was the lowest in many years.

Figure 1 shows trends in the domestic crude-feldspar industry since 1910.

Output of crude feldspar in 1938 amounted to 196,119 long tons valued at $895,081, a decrease of 27 percent in tonnage and 35 percent in value from 1937.

Continued experimentation with froth flotation and agglomerate tabling and a revival of investigations on electrostatic separation were of outstanding interest to the industry in 1938. Three mills are now processing nepheline syenite imported from Canada, and in

November a plant to produce a new fluxing material called "aplite," which has about the same alumina content as nepheline, was put into operation in Virginia. Two new feldspar grinding mills were either under construction or contemplated at the end of the year.

Low-cost western feldspar from South Dakota and Colorado contributed 36 percent of the total crude feldspar output in 1938. North Carolina retained its rank as the largest producing State, but South Dakota displaced Colorado as the second largest producer. All other States, except Arizona and Connecticut, reported decreases in crude-spar output in 1938 compared with 1937. Owing to the larger proportion of western feldspar, the average value per long ton of crude spar in 1938 decreased to $4.56, a drop of 12 percent from 1937.

Sales of ground feldspar by merchant mills in 1938 totaled 214,514 short tons valued at $2,466,252, a decline of 23 percent in tonnage and 29 percent in value compared with 1937. About 4 percent of the total feldspar ground in 1938 came from Canada.

Salient statistics of the feldspar industry in the United States, 1937–38

	1937	1938	Percent change in 1938
Crude feldspar:			
Domestic sales:			
Long tons	268,532	196,119	−27.0
Value	$1,383,249	$895,081	−35.3
Average per long ton	$5.15	$4.56	−11.5
Imports:			
Long tons	12,956	7,652	−40.9
Value	$91,885	$56,133	−38.9
Average per long ton	$7.09	$7.34	+3.5
Ground feldspar sold by merchant mills:			
Short tons	279,272	214,514	−23.2
Value	$3,486,741	$2,466,252	−29.3
Average per short ton	$12.49	$11.50	−7.9

DOMESTIC PRODUCTION

In accordance with the usual practice in the industry, crude spar is reported in long tons of 2,240 pounds and ground spar in short tons of 2,000 pounds.

Crude feldspar.—In 1938, 196,119 long tons of crude feldspar worth $895,081 were sold or used in the United States, a decrease of 27 percent in tonnage and 35 percent in value from 1937. Owing to the relatively low value and greater output of western spar, the average sales realization in 1938 for the country as a whole dropped to $4.56 per long ton, the lowest figure since 1917.

Crude feldspar sold or used by producers in the United States, 1934–38

Year	Long tons	Value		Year	Long tons	Value	
		Total	Average			Total	Average
1934	154,188	$853,136	$5.53	1937	268,532	$1,383,249	$5.15
1935	189,550	1,005,021	5.30	1938	196,119	895,081	4.56
1936	244,726	1,303,090	5.32				

Crude feldspar was produced commercially in 12 States in 1938, the same number as in 1937. No output was reported from Maryland, and Wyoming appears as a producer for the first time. North Carolina retained its rank as the largest producing State in spite of a drop in output to 56,795 long tons in 1938 from 94,595 tons in 1937 and 102,393 tons in 1936. South Dakota displaced Colorado as the second largest producer of crude spar and increased its output to 42,297 tons in 1938, 2 percent over the 1937 figure. Colorado's production, however, declined to 27,452 tons in 1938, or 35 percent below the 1937 figure. Substantial decreases were reported from all other States except Arizona and Connecticut. The output in Arizona, although small, increased considerably.

The average values per long ton f. o. b. mine in 1938 were $3.81 and $2.90 in Colorado and South Dakota, respectively, compared with $4.94 in Maine, $5.31 in New Hampshire, and $5.21 in North Carolina.

Crude feldspar sold or used by producers in the United States, 1936–38, by States

[Value at mine or nearest shipping point]

State	1936		1937		1938	
	Long tons	Value	Long tons	Value	Long tons	Value
Arizona	(1)	(1)	(1)	(1)	(1)	(1)
California	4,700	$41,050	1,836	$9,660	1,396	$7,675
Colorado	25,806	101,950	42,221	178,148	27,452	104,673
Connecticut	(1)	(1)	(1)	(1)	7,461	45,153
Maine	16,392	91,265	20,191	110,928	13,764	68,047
Maryland	(1)	(1)	(1)	(1)		
New Hampshire	26,494	157,729	28,831	155,925	25,555	135,760
New York	(1)	(1)	(1)	(1)	(1)	(1)
North Carolina	102,393	591,053	94,595	538,567	56,795	295,800
Pennsylvania	144	828	(1)	(1)	(1)	(1)
South Dakota	32,144	103,671	41,392	158,976	42,297	122,467
Virginia	20.459	114,807	22,175	125,396	9,766	52,037
Wyoming					1,168	4,343
Undistributed	16,194	100,737	17,291	105,649	10,465	59,126
	244,726	1,303,090	268,532	1,383,249	196,119	895,081

1 Included under "Undistributed."

Ground feldspar.—Sales of ground feldspar in 1938 from 30 merchant mills declined to 214,514 short tons worth $2,466,252, 23 percent less in tonnage and 29 percent less in value than in 1937. The 30 mills (1 less than in 1937) represented 23 producing companies operating in 14 States. Western mills (two in Colorado and two in South Dakota) furnished 35 percent of the total ground spar sold in 1938 compared with 30 percent in 1937 and 23 percent in 1936. The combined share of North Carolina and Tennessee mills, on the other hand, represented only 29 percent of the total in 1938 compared with 33 percent in 1937 and 36 percent in 1936. Three mills grinding imported Canadian spar in 1938 produced about 4 percent of the total quantity of ground feldspar sold compared with four mills producing 6 percent in 1937. Additional quantities of domestic and perhaps imported spar are ground by certain companies for use in their own plants and are not included in the Bureau of Mines statistics, but the quantity is believed to be small compared with the output of merchant mills.

In 1938 South Dakota for the first time produced more ground feldspar than any other State, advancing from third place in 1937. As recently as 1928, no spar was ground in South Dakota. Colorado was second in output, followed by North Carolina and Tennessee. Ground spar produced by Tennessee and North Carolina together totaled 61,467 short tons in 1938, 32 percent less than in 1937. Production in South Dakota in 1938 reached 42,489 tons, an all-time record for the State; and that in Colorado declined to 33,529 tons, a 23-percent decrease. Arizona, whose output may not be published, was the only State other than South Dakota that increased production over 1937. New Jersey's output declined 5 percent to 13,901 short tons. Other States reported sizable decreases in 1938 compared with 1937.

Ground feldspar sold by merchant mills [1] in the United States, 1934–38

Year	Number of active mills	Domestic			Canadian			Total	
		Short tons	Value		Short tons	Value		Short tons	Value
			Total	Average		Total	Average		
1934	26	136,820	$1,731,528	$12.66	7,358	$136,972	$18.62	144,178	$1,868,500
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

[1] Excludes potters or others who grind for consumption in their own plants.

Ground feldspar sold by merchant mills [1] in the United States, 1936–38, by States

State	1936			1937			1938		
	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	4,189	$68,461	3	1,888	$30,427	3	1,263	$17,561
Colorado	1	28,034	206,550	2	43,618	307,412	2	33,529	219,699
Illinois	2	(2)	(2)	1	(2)	(2)	1	(2)	(2)
Maine	3	17,293	253,258	4	22,090	303,449	4	15,651	196,460
Minnesota	1	(2)	(2)	1	(2)	(2)	1	(2)	(2)
New Hampshire	2	(2)	(2)	2	(2)	(2)	2	(2)	(2)
New Jersey	3	14,430	286,940	3	14,700	287,577	3	13,901	258,123
New York	4	(2)	(2)	4	(2)	(2)	4	(2)	(2)
Ohio	2	(2)	(2)	2	(2)	(2)	1	(2)	(2)
North Carolina Tennessee	3 2	85,240	1,153,466	3 2	90,696	1,239,149	3 2	61,467	821,686
South Dakota	2	26,486	255,888	2	40,325	316,834	2	42,489	300,192
Virginia	1	(2)	(2)	1	15,609	229,295	1	8,940	117,874
Undistributed		61,218	930,290		50,346	772,598		37,274	534,657
	30	236,890	3,154,853	31	279,272	3,486,741	30	214,514	2,466,252

[1] Excludes potters or others who grind for consumption in their own plants.
[2] Included under "Undistributed."

The average value per short ton of ground feldspar produced by merchant mills in 1938 fell to $11.50, the lowest figure for many years, and ranged from $6.55 to $21.09 per ton in the various States. Sales realizations for Colorado and South Dakota in 1938 were respectively $6.55 and $7.07 compared with average values in the Eastern States as follows: New Jersey, $18.57; Tennessee-North Carolina, $13.37; Maine, $12.55; and Virginia, $13.19. Sales of ground feldspar manufactured from Canadian crude in 1938 averaged $19.26 per short ton compared with $18.86 per ton in 1937.

Feldspar grinding mills in the United States are listed below:

Feldspar grinders in the United States

Name and address of grinder	Location of mill
ARIZONA:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Kingman.
CALIFORNIA:	
Chamberlain Co., Inc., 2550 East Olympic Blvd., Los Angeles.	Los Angeles.
Gladding, McBean & Co., 1919 East 52d St., Los Angeles	Do.
Industrial Minerals & Chemical Co., 6th and Gilman Sts., Berkeley.	Berkeley.
Standard Sanitary Mfg. Co., Pacific Mines, Campo	Campo.
COLORADO:	
Colorado Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Canon City.
Western Feldspar Milling Co., 1333 W. Maple Ave., Denver	Denver.
ILLINOIS:	
Abingdon Sanitary Mfg. Co., Abingdon	Abingdon.
MAINE:	
Ceramic Feldspar Co., Bath	Bath.
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Topsham.
Oxford Mining & Milling Co., West Paris	West Paris.
Topsham Feldspar Co., Brunswick	Cathance.
MINNESOTA:	
Feldspar Products Co., Warroad	Warroad.
NEW HAMPSHIRE:	
Golding-Keene Co., 29 Ralston St., Keene	Keene.
Seaboard Minerals Corporation, 52 William St., New York, N. Y.	Cold River.
NEW JERSEY:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton.	Trenton.
Eureka Flint & Spar Co., Inc., New York Ave., Trenton	Do.
Standard Flint & Spar Corporation, 1401 New York Ave., Trenton.	Do.
NEW YORK:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Bedford and Rochester.
Genesee Feldspar Co., Inc., 360 Boxart St., Rochester	Rochester.
White Hill Mineral Co., Inc., Gouverneur	DeKalb.
NORTH CAROLINA:	
Feldspar Milling Co., Inc., Burnsville	Bowditch.
Southern Feldspar, Inc., Toecane	Toecane.
Tennessee Mineral Products Corporation, Spruce Pine	Spruce Pine.
OHIO:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	East Liverpool.
SOUTH DAKOTA:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Keystone.
F. E. Schundler Feldspar Co., Custer	Custer.

Feldspar grinders in the United States—Continued

Name and address of grinder	*Location of mill*
TENNESSEE:	
Consolidated Feldspar Corporation, Trenton Trust Bldg., Trenton, N. J.	Erwin.
North Carolina Feldspar Corporation, Erwin	Do.
VIRGINIA:	
Seaboard Feldspar Co., Hearst Tower Bldg., Baltimore, Md.	Brookneal.
Virginia Feldspar Co., Bedford	Bedford.

CONSUMPTION AND USES

Although the bulk of the crude spar produced is processed by merchant mills, two sanitary-products manufacturers have their own quarries and milling equipment. A few miners of crude spar sell all or part of their higher-grade product in the crude state to soap and cleanser manufacturers, who use it after grinding as a mild abrasive in their products.

As heretofore, by far the larger part of the output of ground feldspar was consumed in the glass, pottery, and enamel industries. In 1938 glass manufacturers used 55 percent of the feldspar produced, pottery lines about 35 percent, and the enamel trades about 9 percent. The small remainder was used for miscellaneous purposes, chiefly ceramic.

Ground feldspar sold by merchant mills in the United States, 1936–38, by uses, in short tons

Use	1936		1937		1938	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Ceramic: [1]						
Glass	121,677	51.4	142,028	50.9	117,800	54.9
Pottery	76,527	32.3	[1] 102,346	36.6	[1] 74,035	34.5
Enamel and sanitary ware	23,746	10.0	[1] 25,111	9.0	[1] 19,395	9.0
Insulators and other porcelain goods	5,105	2.1	(1)		(1)	
Brick and tile	6,074	2.6	(1)		(1)	
Other ceramic uses	1,839	.8	[1] 6,442	2.3	[1] 2,077	1.0
Soaps and abrasives	1,328	.8	1,653	1.2	1,207	.6
Binder for abrasive wheels	584		242			
Other uses	10		1,450			
	236,890	100.0	279,272	100.0	214,514	100.0

[1] New classification for ceramic uses adopted in 1937 was as follows: Glass, pottery, enamel, and other ceramic. Except for glass, figures for 1937–38 are not directly comparable with those for earlier years.

All outlets for feldspar reduced their requirements in 1938. This slackening of demand is indicated by the 18-percent drop in production of glass containers in 1938 and the even greater decrease in output of plate and window glass. Output of porcelain-enameled flatware and sales of electric ranges and electric refrigerators for household use dropped sharply from 1937 levels. Production of bathroom accessories declined moderately.

TECHNOLOGIC DEVELOPMENTS

In the earlier years of the feldspar industry neither producers nor consumers paid much attention to exact specifications, but as the ceramic and glass industries began to insist upon rigid chemical control of batch ingredients definite standards were developed for alumina, lime, and alkali content, as well as stricter limits for iron.

To meet these conditions the feldspar mills were remodeled; laboratory control was introduced, and arrangements were made for stocking different grades of spar and blending them into products of known and guaranteed composition. Almost before the industry had put its house in order, however, competition arose from other mineral products heretofore not on the market. These new materials, particularly nepheline syenite from Canada and, later, "aplite" from Virginia, were developed largely through the search for fluxes of higher alumina content for use chiefly in the glass industry. Increased consumption of talc and pyrophyllite in the manufacture of whiteware bodies and other ceramic products likewise has affected the use of feldspar.

Magnetic separators have been installed in the larger mills to insure a low-iron product. Other processing methods long employed in ore dressing are being adapted to beneficiate nonmetallic minerals. Froth flotation, in particular, is well suited to the purification of feldspar, quartz, clay, talc, nephelite, spodumene, and other ceramic raw materials. Cationic reagents, such as certain substituted ammonium compounds and nitrogen bases, seem especially useful in selectively filming acidic minerals including quartz, feldspar, mica, or other silicates.

Allied to froth flotation in principle but radically different in nature of equipment is agglomerate tabling. In this process, which successfully treats much coarser sizes than can be handled by flotation, the separation is made on a shaking table. The selectively oiled particles agglomerate into loosely adherent balls which are rolled across the riffled surface regardless of specific gravity. A quartz-feldspar mine at Keene, N. H., is using this method and is reported to obtain a feldspar containing less than 2 percent impurities and virtually pure quartz as a byproduct.

The use of highly selective methods allows separation of both soda and potash feldspars from the quartz.[1] For this operation the cationic reagents previously employed in Bureau of Mines research on nonmetallic mineral separations are supplemented by a newly discovered activator.

Electrostatic separation has been improved to afford another potentially commercial means of removing impurities from feldspar. Better methods of beneficiation and more efficient refining practice have made possible the treatment of lower-grade mixed feldspar-quartz rock and even the utilization of old dump material as a source of good feldspar. The making of clean, salable spar economically from previously worthless quarry waste, and even from granite, gneiss, or other relatively fine grained rock, is of major importance in the older feldspar-mining areas where the most-accessible pegmatite deposits

[1] O'Meara, R. G., Norman, J. E., and Hammond, W. B., Flotation and Agglomerate Separation of Quartz and Feldspar: Bull. Am. Ceram. Soc. (abs.), vol. 18, No. 4, April 1939, p. 127.

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have been worked out and where recent competition from western spar and substitute materials has been most severe.

Results of an extensive field survey of the feldspar deposits of eight Virginia counties were published by the Virginia Polytechnic Institute.[2] Details of processes for purifying feldspar by magnetic separation have been described recently.[3] Direct determination of sodium oxide in feldspar was effected by Koenig.[4] Shelton [5] and Meyer reported on the effect of the rate of heating on the glass phase and the physical properties of whiteware bodies.

Utilization of iron- and steel-plant slag in glassmaking batches is reported from India.[6] Orthoclase feldspar combined with the slag, it is stated, makes a glass suitable for the manufacture of transparent as well as opaque and black bottles, jars, floor tiles, roof tiles, and other products. The large percentages of potash give good brilliance, and chemical durability is satisfactory owing to the almost equal proportions of potash and soda. Costs are claimed to be reduced about 50 percent as a result of the use of slag as a batch ingredient.

A German patent [7] describes the separation of mica and feldspar from the gangue rocks by a flotation process in which carbolic acid or creosote oil, a higher aliphatic acid or a salt thereof, and a terpineol are used together as flotation agents.

The economic significance of the feldspar deposits of middle, eastern, and southern Europe was described and production and export statistics were given by Kirnbauer.[8]

Nepheline syenite.—Three mills in the United States are now processing nepheline syenite for use in glass manufacture. Two of them—the American Nepheline Corporation, Rochester, N. Y., a subsidiary of Canadian Nepheline, Ltd., and the New England Nepheline Co., Keene, N. H., affiliated with Golding-Keene Co.—were in operation in 1937. The Oxford Mining & Milling Co., West Paris, Maine, a subsidiary of the United Feldspar Corporation, began grinding nepheline later. Crude rock for these mills is imported from Canada, mostly from Blue Mountain, Peterborough County, central Ontario, and from the neighboring counties of Hastings and Haliburton. Spence [9] has described the mining in this region and the processing both at Lakefield, Ontario, and at Rochester.

In wall tile and floor tile, according to Koenig,[10] the greater refractoriness of certain American clays is offset by additions of nepheline syenite, owing to its active fluxing action. Nepheline also permits the making of satisfactory floor-tile bodies at lower temperatures.

[2] Dear, Paul S., Matthews, A. A. L., and Whittemore, John W., Investigation of Some Virginia Feldspars: Virginia Polytech. Inst. Eng. Exp. Sta. Bull. 35, December 1938, 48 pp.; Ceram. Abs., vol. 18, No. 3, March 1939, p. 85.

[3] Feldspathic Research Corporation, C. H. Peddrick, Jr., and J. H. Weis, Feldspar: Canadian Patent 369,922, Nov. 16, 1937; Chem. Abs., vol. 32, No. 6, Mar. 20, 1938, p. 2308.

[4] Koenig, E. W., Direct Determination of Sodium Oxide in Feldspar: Jour. Am. Ceram. Soc., vol. 22, No. 1, January 1939, pp. 24–31.

[5] Shelton, G. R., and Meyer, W. W., Nature of the Glass Phase in Heated Clay Materials: Jour. Am. Ceram. Soc., vol. 21, No. 11, November 1938, pp. 371–385.

[6] Varshney, V. P., Science and Culture: Vol. 4, No. 1, 1938, pp. 45–47: Ind. and Eng. Chem., News Ed., vol. 16, No. 23, Dec 10, 1938, p. 640.

[7] Chemische Werke Schonebeck A. G. et al., G. Gerth., Separating Mica and Feldspar: German Patent 654,032, Dec. 9, 1937; Chem. Abs., vol. 32, No. 6, Mar. 20, 1938, p. 2302–2303.

[8] Kirnbauer, F., Productive Feldspar and Kaolin Deposits in Middle, East, and South Europe and Their Economic Importance: Berg-u. Hüttenmänn. Jahrb. Montan. Hochschule Leoben, vol. 85, Nos. 3–4, 1937, pp. 291–297; Ceram. Abs., vol. 17, No. 5, May 1938, p. 197.

[9] Spence, Hugh S., Nepheline Syenite: A New Ceramic Raw Material from Ontario: Am. Inst. Min. and Met. Eng., Tech. Pub. 951, New York, 1938, 9 pp.

[10] Koenig, C. J., Use of Nepheline Syenite in Floor- and Wall-Tile Bodies: Bull. Am. Ceram. Soc., vol. 18, No. 4, April 1939, p. 138.

Crude nepheline syenite is bound free of duty in the Reciprocal Trade Agreement with Canada. There is a reservation, however, that if the imports of crude and ground material combined in any year exceed 50,000 tons the Canadian and the United States Governments will consult on measures to be taken. If no agreement is reached the United States reserves the right to impose a customs duty on imports in excess of the 50,000 tons stipulated. For the ground product this charge would be in addition to the present duty, which was reduced from 30 to 15 percent by the agreement.

Aplite.—In November 1938 another new high-alumina ceramic flux was made available to glass and pottery manufacturers. This material, known as aplite, which occurs near Piney River, Amherst County, Va., is a highly altered, white, massive rock consisting of albite and microcline feldspars, sericite, zoisite, clinozoisite, and other minerals. A typical analysis shows 59.80 percent SiO_2, 0.397 percent Fe_2O_3, 24.29 percent Al_2O_3, 5.86 percent CaO, 5.82 percent Na_2O, and 2.67 percent K_2O. Even with magnetic separators the iron content cannot readily be reduced below about 0.2 or 0.3 percent, which bars its use in clear-glass products but not in colored-glass containers, such as milk, liquor, and cosmetic bottles and similar glassware. The deposit, which apparently is quite extensive, is being developed by Dominion Minerals, Inc. Chemical and mineralogical content and physical properties of the rock were described in detail and the possibilities of its use for various ceramic purposes discussed by Dear and Whittemore.[11]

At the present stage of operation, until its iron content can be reduced further, aplite can be used in clear glass or white pottery only as a supplement to, rather than as a substitute for, feldspar. A blend of aplite and feldspar carries more alumina than the average commercial feldspar, but the proportion of aplite is limited strictly by the permissible iron content. Aplite, however, is cheaper than feldspar because it can be quarried by ordinary methods as it occurs in massive formations rather than in irregulr pockets in pegmatite veins or lenses.

Volcanic ash.—Further encroachment upon markets now supplied largely by feldspar is foreshadowed by recent tests of volcanic ash as a glaze constituent in glass batches. Plummer [12] reported the successful use of volcanic ash or pumicite in both fritted and raw glazes to replace the feldspar and part of the flint. Although in some of the glazes tested the ash content was more than 50 percent of the batch and the maturing temperature ranged from cones 09 to 8, no significant difference could be detected between the volcanic-ash glazes and control glazes of nearly identical chemical composition except the color effects due to the higher iron content of the pumicite.

The finely divided nature of the ash in its raw untreated state and its low cost, about $2 a ton, f. o. b., would be important factors in its possible utilization in glass batches and in colored glazes for roofing tile, wall tile, and low-priced pottery. About 1½ parts of the ash are said to be equivalent to 1 part of feldspar. Abundant supplies of non-weathered ash are available in southwest Kansas and northwest Oklahoma, particularly in McPherson County, Kans., and near Gate,

[11] Dear, P. S., and Whittemore, J. W., Aplite, A New Ceramic Material: Bull. Am. Ceram. Soc. (abs.), vol. 18, No. 4, April 1939, p. 138.

[12] Plummer, Norman, Ceramic Uses of Volcanic Ash: Bull. Am. Ceram. Soc., vol. 18, No. 1, January 1939, pp. 8–11.

Okla. K. K. Landes,[13] assistant State geologist of Kansas, at Lawrence, recently has devoted much time and energy to the adaptation of volcanic ash to industrial use. Other selected references[14] may be of interest.

FOREIGN TRADE

Effective January 1, 1939, under the Reciprocal Trade Agreement with Canada—virtually the only source of feldspar imports into the United States—the duty on crude spar was reduced to 25 cents a ton and that on ground spar to 15 percent. The rate on crude spar as specified in paragraph 207 of the Tariff Act of 1930 was $1 a long ton but was cut to 50 cents on January 1, 1932, by Presidential proclamation and to 35 cents under the first Canadian Trade Agreement. The latest 10-cent reduction brings the rate to only one-fourth of that provided in the Tariff Act of 1930 when the material was removed from the free list. Simultaneously, the Canadian duty on ground feldspar imported from the United States was lowered from 20 to 15 percent—the same rate as that levied on imports into the United States.

Imports.[15]—Both the tonnage and value of imports for consumption of crude feldspar in 1938, all from Canada, decreased approximately 40 percent—to 7,652 long tons worth $56,133 from 12,956 tons worth $91,885 in 1937. The average value per ton (foreign market value), however, increased to $7.34 in 1938 from $7.09 in 1937. In 1938, as in 1937, no ground feldspar was imported.

Feldspar imported for consumption in the United States, 1934–38

Year	Crude		Ground		Year	Crude		Ground	
	Long tons	Value	Short tons	Value		Long tons	Value	Short tons	Value
1934	9,744	$67,258			1937	12,956	$91,885		
1935	8,937	56,175	1	$106	1938	7,652	56,133		
1936	10,786	68,198	132	1,276					

Probably owing to the increased use of natural or artificially blended materials of domestic origin, receipts of Cornwall stone receded sharply in 1938. Imports of the manufactured stone dropped to 513 long tons valued at $4,976, from 1,899 tons valued at $16,864 in 1937. Imports of ground Cornwall stone also decreased, amounting to 233 long tons valued at $1,797 compared with 323 tons valued at $4,267 in 1937. Crude and ground material originated in the United Kingdom in both 1937 and 1938.

[13] Landes, K. K., Distribution of Volcanic Ash: Paper presented at 40th Ann. Meeting, Am. Ceram. Soc. New Orleans, Mar. 28, 1938.

[14] Moore, B. N., Pumice and Pumicite: Am. Inst. Min. and Met. Eng., Industrial Minerals and Rocks, New York, 1937, p. 601–607.

———, Nonmetallic Mineral Resources of Eastern Oregon: Geol. Survey, Bull. 875, 1937, 180 pp.

Singleton-Greene, G., Pumice as an Aggregate in Concrete: Sands, Clays, and Minerals, vol. 3, No. 2, 1937. pp. 109–112.

Baker, C. L., Volcanic Ash in Texas: Univ. Texas Bureau Econ. Geol., Mineral Resources Circ. 2, December 1931.

Preston, F. W., Volcanic Ash as a Constituent of Glass Batches: Glass Ind., vol. 16, No. 4, 1935, p. 111; Ceram. Abs. vol. 14, No. 6, 1935, p. 138.

[15] 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

Sweden, Norway, China, and probably Czechoslovakia are the chief producers of feldspar aside from the United States. Smaller outputs regularly come from Germany (Bavaria), Italy, Rumania, Finland, Australia, and other widely separated countries. A large part of the Canadian crude-spar production is shipped to grinding mills in the United States for processing.

Available figures on world production of feldspar, 1934 to 1938, inclusive, follow.

World production of feldspar, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1934	1935	1936	1937	1938
Argentina (shipments)	431	495	1,082	(2)	(2)
Australia:					
New South Wales [3]	891	166	101	162	(2)
South Australia [3]	212	315	553	669	(2)
Western Australia (exports)	1,845	2,703	3,047	3,031	(2)
Brazil	(2)	(2)	(2)	8,400	(2)
Canada (shipments)	16,603	16,095	16,190	19,365	12,817
China [4]	27,780	(2)	(2)	(2)	(2)
Egypt	----------	72	45	158	(2)
Finland (exports)	3,329	2,071	2,520	3,232	(2)
France	----------	----------	----------	8,900	(2)
Germany (Bavaria)	6,808	6,337	9,524	9,986	(2)
India, British	638	713	798	495	(2)
Italy	7,637	7,616	8,620	13,437	(2)
Norway (exports)	22,139	24,228	29,985	32,555	21,761
Rumania	1,026	14,180	1,960	(2)	(2)
Sweden	34,468	48,637	56,799	49,140	(2)
United States (sold or used)	156,663	192,592	248,654	272,842	199,267

[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.
[4] Includes Manchuria.

ASBESTOS

By Oliver Bowles and K. G. Warner

SUMMARY OUTLINE

Asbestos may be termed indispensable to modern life. As the chief constituent of brake-band linings and clutch facings it is essential to automotive transport; in the form of gaskets and packings it is a necessary part of steam-driven machinery; as a heat insulator it plays an important role in both household and factory construction and equipment; and combined with cement it is employed in the manufacture of vast quantities of roofing and other building materials.

The United States is the largest asbestos-consuming country in the world but produces only a small fraction of its requirements of raw materials. In 1938 domestic sales amounted to 6 percent of the quantity and 4 percent of the value of domestic requirements. How could our needs be met in an emergency?

Stimulation of domestic production bears little promise. Although many occurrences of chrysotile asbestos have been noted in the United States, few seem to have commercial possibilities. Arizona deposits furnish excellent crude fiber; but mining costs are high, transportation difficult, and freight rates to eastern markets excessive. Although Vermont deposits are extensive and can produce large quantities of mill fibers of moderate to short lengths, they furnish little fiber of spinning grade. Chrysotile deposits are known in California and some other States, but none appear to be capable of development into consistent producers.

The possibility of making synthetic asbestos to take the place of the natural fiber has been suggested; but, because of the special qualities of high-grade fiber that man cannot duplicate in a laboratory, the manufacture of a satisfactory product seems to be farther from attainment than the manufacture of synthetic diamonds.

Another alternative is substitution of other materials for the major uses of asbestos. Some progress has been made in this direction. Synthetic fibers such as mineral wool, slag wool, and glass wool, now made in large quantities, are related in no way to asbestos in composition yet have physical qualities that permit their employment in some fields of usefulness wherein asbestos has heretofore been used exclusively. In the heat-insulation field particularly the mineral-wool fibers have made some headway, but until it is demonstrated that they can be adapted to the other major uses the United States evidently must continue to depend on foreign sources for its major supplies of asbestos.

The following table of salient statistics shows that domestic production in 1938 was 7 percent lower than in 1937. Asbestos sold or used by producers in 1938 decreased 14 percent in quantity and 28 percent in value compared with 1937. The large decline in unit value was due primarily to sales of an unusually high proportion of the shorter fibers produced in Arizona—a favorable development because heretofore sales have been confined principally to crudes on account of the high cost of transportation. With a well-equipped mill now catering particularly to the west-coast trade in shorter fibers, producers are provided with an avenue for sale of the lower-grade fibers that formerly were left on their hands. Compared with 1937, apparent consumption in the United States in 1938 dropped 41 percent in quantity and 42 percent in value.

Salient statistics of the asbestos industry in the United States, 1937–38

	1937		1938	
	Short tons	Value	Short tons	Value
Domestic asbestos—				
Produced:				
Chrysotile	13,284	(1)	(2)	(1)
Amphibole	612	(1)	(2)	(1)
Total produced	13,896	(1)	12,901	(1)
Sold or used by producers:				
Chrysotile	11,547	$332,747	(2)	(2)
Amphibole	532	11,897	(2)	(2)
Total sold or used by producers	12,079	344,644	10,440	$247,264
Imports (unmanufactured)	307,188	10,470,208	179,490	6,160,602
Exports (unmanufactured)	3,004	253,734	2,780	288,617
Apparent consumption [3]	316,263	10,561,118	187,150	6,119,249
Exports of asbestos products	(1)	3,047,078	(1)	2,533,916

[1] Figures not available.
[2] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[3] Quantity sold or used by producers, plus imports, minus exports.

Because of the interest that has lately been centered on strategic and critical minerals from a military standpoint and the fact that asbestos has been classed by the Army and Navy Munitions Board as a critical mineral, it seems fitting at this time to present a historic table comprising data on production and consumption for virtually half a century. Prior to 1890, the first year recorded in the table, asbestos had little industrial importance.

Asbestos sold or used by producers and apparent consumption in the United States, 1890–1938

Year	Sold or used by producers						Apparent consumption [1]	
	Chrysotile		Amphibole		Total			
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1890	----------	----------	71	$4,560	71	$4,560	(2)	[3] $257,117
1891	----------	----------	66	3,960	66	3,960	(2)	[3] 357.549
1892	10	$793	94	5,623	104	6,416	(2)	[3] 268,849
1893	----------	----------	50	2,500	50	2,500	(2)	[3] 178,102
1894	----------	----------	325	4,463	325	4,463	(2)	[3] 244,492
1895	(4)	(4)	(4)	(4)	795	13,525	(2)	[3] 238,672
1896	----------	----------	504	6,100	504	6,100	(2)	[3] 235,184
1897	(4)	(4)	(4)	(4)	580	6,450	(2)	[3] 270,090
1898	(4)	(4)	(4)	(4)	605	10,300	(2)	[3] 297,936
1899	(4)	(4)	(4)	(4)	681	11,740	(2)	[3] 314,859
1900	(4)	(4)	(4)	(4)	1,054	16,310	(2)	[3] 348,106
1901	(4)	(4)	(4)	(4)	747	13,498	(2)	[3] 680,585
1902	----------	----------	1,005	16,200	1,005	16,200	(2)	[3] 745,621
1903	(4)	(4)	(4)	(4)	887	16,760	(2)	[3] 674,029
1904	----------	----------	1,480	25,740	1,480	25,740	(2)	[3] 726,312
1905	114	4,615	2,995	38,360	3,109	42,975	(2)	[3] 819,337
1906	155	(5)	1,540	(5)	1,695	28,565	(2)	[3] 1,039,019
1907	----------	----------	653	11,899	653	11,899	(2)	[3] 1,116,008
1908	(4)	(4)	(4)	(4)	936	19,624	(2)	[3] 1,087,946
1909	(4)	(4)	(4)	(4)	3,085	62,603	(2)	[3] 1,055,857
1910	(4)	(4)	(4)	(4)	3,693	68,357	(2)	[3] 1,303,527
1911	(4)	(4)	(4)	(4)	7,604	119,935	(2)	[3] 1,533,476
1912	(4)	(4)	(4)	(4)	4,403	87,959	(2)	[3] 1,543,971
1913	----------	----------	1,100	11,000	1,100	11,000	[3] 98,169	[3] 1,939,705
1914	22	5,450	1,225	13,515	1,247	18,965	(2)	[3] 1,426,719
1915	316	65,148	1,415	11,804	1,731	76,952	[3] 95,298	[3] 2,058,435
1916	808	167,683	830	13,311	1,638	180,994	[6] 117,488	[6] 3,478,331
1917	1,391	279,270	567	11,744	1,958	291,014	135,338	4,695,606
1918	392	101,059	606	17,628	998	118,687	138,001	6,405,242
1919	502	229,265	659	19,000	1,161	248,265	135,312	7,460,534
1920	1,245	661,907	403	16,324	1,648	678,231	168,591	9,657,413
1921	438	313,268	393	23,700	831	336,968	72,774	3,183,670
1922	25	3,320	42	6,800	67	10,120	149,118	5,104,881
1923	69	4,433	158	5,193	227	9,626	211,967	7,406,244
1924	173	33,941	127	8,585	300	42,526	182,280	5,552,308
1925	93	40,750	1,165	10,950	1,258	51,700	230,669	7,115,156
1926	(4)	(4)	(4)	(4)	1,358	134,731	257,875	8,191,314
1927	(4)	(4)	(4)	(4)	2,981	336,882	226,365	8,438,448
1928	(4)	(4)	(4)	(4)	2,239	351,178	231,984	9,022,437
1929	1,983	317,584	1,172	33,420	3,155	351,004	264,873	11,395,554
1930	3,653	273,292	589	15,992	4,242	289,284	212,152	7,258,790
1931	2,857	111,708	371	7,259	3,228	118,967	137,875	3,745,916
1932	(4)	(4)	(4)	(4)	3,559	105,292	98,606	2,260,556
1933	(4)	(4)	(4)	(4)	4,745	130,677	122,909	3,584,639
1934	(4)	(4)	(4)	(4)	5,087	158,347	123,752	3,442,159
1935	(4)	(4)	(4)	(4)	8,920	292,927	174,655	5,330,444
1936	10,719	302,301	345	11,860	11,064	314,161	250,922	7,528,901
1937	11,547	332,747	532	11,897	12,079	344,644	316,263	10,561,118
1938	(4)	(4)	(4)	(4)	10,440	247,264	187,150	6,119,249

[1] Quantity sold or used by producers, plus imports, minus exports, except as indicated.
[2] Data on quantity of asbestos imported not available 1890–1912 and 1914.
[3] Asbestos sold or used by producers, plus imports; data on exports not separately recorded prior to July 1916.
[4] Bureau of Mines not at liberty to publish figures separately for chrysotile and amphibole.
[5] Figures not available.
[6] Export figures cover period July to December 1916.

Consumption trends.—The following table shows trends in the asbestos-products industries of the United States during recent years. The volume of asbestos consumed depends primarily on two great industries—automobile manufacture and the building trades. Although asbestos consumption made remarkable gains in 1937, outstripping both these consuming industries, the reversal in trend in 1938 was just as pronounced. As indicated in figure 1, only about half as many automobiles were manufactured in 1938 as in 1937, and the moderate gain in building contracts failed to stem the downward trend in asbestos consumption that virtually paralleled the decline in output of automobiles.

Raw asbestos consumed in the United States and asbestos products manufactured in and exported from the United States, 1933–38

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*		
1933	122,909	$44,644,270	$1,743,140	1936	250,922	(1)	$2,479,273
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

[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.

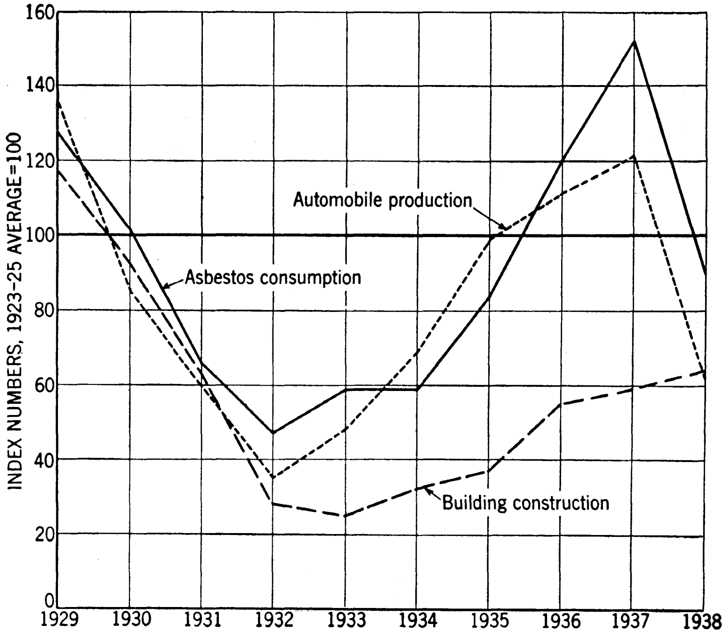

FIGURE 1.—Asbestos consumption compared with automobile production and value of building construction, 1929–38. Unlike units are reduced to percentages of the 1923–25 average. Statistics on automobiles are from the Bureau of the Census and building contracts from the Federal Reserve Board.

Market conditions.—The demand for asbestos in the United States was weak and hesitant throughout most of the year, although there was some evidence of improvement in November and December. European and Japanese markets were more active than those in America.

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, 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 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–$77 ($78 in December); paper stock, $40–$45; cement stock, $21–$25; floats, $18–$20; and shorts, $12–$16.50.

Rhodesian Crude No. 1 was quoted at $275 and Crude No. 2 at $250 until March, when the prices were advanced to $300 and $260, respectively.

South African prices quoted since March 1938 are as follows: Amosite: Grade B 1 (white), $140; Grade B 3 (dark), $120. Transvaal Blue: Grade B (long fiber), $450; 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

A decided increase in the use of molded brake linings in place of those made of asbestos fabric is to be noted. According to figures compiled by the Bureau of the Census, molded brake linings constituted 39 percent of the total footage in 1935 and 56 percent in 1937. One large manufacturer of asbestos products estimates that eventually molded linings may increase to more than 70 percent of the total. Recently a new type of die-formed molded lining made from woven fabric has been developed. Undoubtedly it has been devised by companies equipped for woven linings but desirous of entering the molded-lining field without discarding their present equipment.

A new type of cast pipe made of sulfur employs shredded asbestos as one of its constituents.

A sprayed coating for heat insulation, prevention of corrosion, and noise reduction consists of asbestos fibers and a bonding medium. These materials are projected against the surface in separate streams, and thus a feltlike coating is built up.

REVIEW BY STATES

Arizona.—Both production and sales of chrysotile asbestos, chiefly from Gila County, made further gains in 1938. Sales were made by the Arizona Chrysotile Asbestos Co., Emsco Asbestos Co., and Arthur Enders, all of Globe, Ariz.; and Johns-Manville Products Corporation, New York, N. Y. Arthur Enders operates a mine on the Apache Reservation, under lease from the United States Government. According to report the fiberizing mill of the Emsco Asbestos Co. at Downey, Calif., has a capacity of 600 tons monthly.

Maryland.—The Powhatan Mining Corporation, Woodlawn, Baltimore, Md., produced amphibole asbestos near Pylesville, Harford County, and prepared it for use chiefly in filtering chemicals. For many years this material has been designated anthophyllite. Although some anthophyllite may be present in the deposit, the principal product has been identified definitely as tremolite.

Vermont.—The name of the company operating the well-known property at Eden, Lamoille County, has been changed to Vermont Asbestos Mines, division of the Ruberoid Co. (address 500 Fifth Avenue, New York, N. Y.). This company is the largest producer of asbestos in the United States.

Other States.—Plans are being made to resume operations at the Morgan asbestos mine in Placer County, Calif., and also for developing a property 9 miles from Glenrock, Converse County, Wyo. It has been reported to the Bureau of Mines that the Karstolite Co. no longer operates the anthophyllite deposit in Gallatin County, Mont.; but a new company, the Montana Asbestos Co., is in process of organization.

FOREIGN TRADE [1]

The following table shows imports of unmanufactured asbestos into the United States by countries and classes in 1937 and 1938. The total imports declined 42 percent in quantity and 41 percent in value. The decrease was shared by all countries furnishing substantial supplies except Italy, whose imports increased 59 percent. Imports from Cyprus fell from over 8,000 tons to an insignificant quantity.

Asbestos (unmanufactured) imported for consumption in the United States, 1937–38, 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
1937								
Africa, British:								
Union of South Africa	4,247	$490,335			1	$27	4,248	$490,362
Other British	7,099	794,256					7,099	794,256
Canada	2,620	556,034	95,788	$4,775,513	177,602	2,984,299	276,010	8,315,846
Finland					88	3,568	88	3,568
France					122	1,735	122	1,735
Italy	31	22,332			958	19,755	989	42,087
Malta, Gozo, Cyprus					8,129	310,058	8,129	310,058
U. S. S. R.	39	8,464	7,978	363,804	2,196	85,392	10,213	457,660
United Kingdom	290	54,636					290	54,636
	14,326	1,926,057	103,766	5,139,317	189,096	3,404,834	307,188	10,470,208
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.

The following table shows imports and exports of unmanufactured asbestos for the 5-year period 1934–38:

[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 and exported from the United States, 1934–38

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1934	120,334	$3,377,994	1,669	$94,182
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

The following table shows exports of asbestos products in 1937 and 1938:

Manufactured asbestos products exported from the United States, 1937–38, by kinds

Product	1937		1938	
	Quantity	Value	Quantity	Value
Brake lining:				
Molded and semimolded	(1)	$722,075	(1)	$608,970
Not molded ... linear feet	1,633,558	250,955	923,672	176,765
Clutch facing ... number	499,870	140,711	448,121	134,209
Paper, millboard, and roll board ... short tons	869	183,610	725	100,034
Pipe covering and cement ... do	2,384	197,000	1,143	128,666
Textiles, yarn, and packing ... do	762	789,398	565	611,549
Asbestos roofing ... squares	37,026	166,312	83,080	225,987
Other asbestos manufactures, except roofing short tons	1,889	324,100	1,593	293,272
Magnesia and manufactures ... do	1,567	272,917	1,601	254,464

[1] Quantity not recorded.

WORLD PRODUCTION

The following table shows world production of asbestos, by countries, from 1934 to 1938, insofar as figures are available:

World production of asbestos, 1934–38, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Argentina		[2] 13			(3)
Australia:					
South Australia		36	81	123	(3)
Western Australia	157	143	162	43	(3)
Bolivia			(4)	21	21
Bulgaria	3	3			(3)
Canada [5]	141,502	190,931	273,322	371,967	262,970
China	290	(3)	(3)	(3)	(3)
Chosen	4	6	69	70	(3)
Cyprus [6]	7,712	7,634	9,659	11,892	5,668
Czechoslovakia	2,100	2,600	2,700	(3)	(3)
Finland	1,735	1,742	3,963	3,330	(3)
France	400	450	405	250	(3)
Greece	30	2	1	2	(3)
India, British	25	64	57	102	(3)
Indochina			5	5	(3)
Italy	2,252	4,320	6,113	6,393	(3)
Japan [7]	1,000	1,000	1,000	1,000	1,000
Southern Rhodesia	29,224	38,644	51,116	51,722	53,352
Turkey	4	104	119	157	(3)
Union of South Africa	15,960	20,600	22,894	25,975	21,025
U. S. S. R.	92,200	95,500	125,117	(3)	(3)
United States (sold or used by producers)	4,615	8,092	10,037	10,958	9,471
Venezuela		76	71	(3)	(3)

[1] In addition to countries listed, a small quantity of asbestos is reported from 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: 1934, 4,238 tons; 1935, 2,744 tons; 1936, 2,815 tons; 1937, 3,611 tons; 1938, 2,975 tons.
[6] Exports.
[7] Approximate production.

CANADA

Sales of asbestos in Canada during 1938 declined 29 percent in quantity and 11 percent in value from the all-time high level of 1937. The entire production was from the Province of Quebec. The well-known deposits of this Province have been described in detail by Cooke.[2]

An improved all-metal standard testing machine recently devised retains the essential principle of the old machine.

In September 1938 it was reported that a new asbestos discovery had been made 260 miles north of North Bay, Ontario, but no details are available. Some publicity has been given to a new discovery on an island in Lake of the Woods, Ontario, but the material appears to be anthophyllite, which has little commercial importance at present. The following table shows sales in 1937 and 1938, as published in the Preliminary Report on the Mineral Production of Canada in 1938, issued by the Dominion Bureau of Statistics:

Sales of asbestos in Canada, 1937–38

	1937			1938		
	Short tons	Value		Short tons	Value	
		Total	Average per ton		Total	Average per ton
Grade:						
Crudes	3,846	$947,917	$246.47	2,910	$955,424	$328.32
Fibers	200,247	10,235,820	51.12	163,182	9,714,509	59.53
Shorts	205,933	3,322,054	16.13	123,785	2,223,873	17.97
	410,026	14,505,791	35.38	289,877	12,893,806	44.48
Sand, gravel, and stone (waste rock only)	3,980	3,301	.83	3,279	2,464	.75
Total asbestos and waste rock	414,006	14,509,092		293,156	12,896,270	
Rock mined	6,477,805			5,816,368		
Rock milled	5,440,607			4,874,548		

AFRICA

Southern Rhodesia.—The output of asbestos in Southern Rhodesia in 1938 exceeded by 3 percent the record production of 1937. The following table shows production during recent years:

Asbestos produced in Southern Rhodesia, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	32,214	£402,745	1937	57,014	£840,025
1935	42,598	646,658	1938	58,811	1,020,921
1936	56,346	836,469			

Union of South Africa.—The output in the Union of South Africa in 1938 dropped 19 percent below that of 1937. Natal has again become a producer in a small way. The following table shows production during recent years:

[2] Cooke, H. C., Thetford, Disraeli, and Eastern Half of Warwick Map-Areas, Quebec: Canada, Dept. of Mines and Resources, Geol. Survey, Mem. 211, 1937, pp. 86–140.

Asbestos produced in the Union of South Africa, 1934–38, by sources

Year	Short tons				Total value
	Transvaal	Cape Province	Natal	Total	
1934	14,783	2,810		17,593	£203,033
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

[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 shows the tonnage of each variety produced from 1934 to 1938. A noteworthy feature is the striking decrease in chrysotile from Transvaal. This probably represents the effect of the reported early depletion of the Amianthus mine.

Asbestos produced in the Union of South Africa, 1934–38, by varieties and sources, in short tons

Variety and source	1934	1935 [1]	1936 [1]	1937 [2]	1938 [2]
Amosite (Transvaal)	3,757	4,684	4,823	6,531	8,793
Chrysotile (Transvaal)	11,025	15,483	16,149	16,855	[3] 5,573
Blue (Transvaal)	1	2,541	216	535	2,326
Blue (Cape)	2,810		4,048	4,712	6,484
	17,593	22,708	25,236	28,633	23,176

[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 Natal.

Swaziland.—In January 1939 it was reported that development of the Havelock mine was proceeding satisfactorily and that production during 1939 was expected.

CYPRUS

Tunnel Asbestos Cement (Ltd.) opened three new quarries during 1938. The following table, compiled mainly from the Annual Report of the Inspector of Mines and Labor, shows exports during recent years. Short-fiber chrysotile is produced.

Asbestos exported from Cyprus, 1934–38

Year	Long tons	Value	Year	Long tons	Value
1934	7,590	[1] £73,562	1937	11,704	£126,371
1935	7,513	50,174	1938	5,578	88,290
1936	9,506	80,343			

[1] Reported by Cyprus & General Asbestos Co. (Ltd.).

U. S. S. R.

The following table shows the most recent available statistics concerning Russian fibers:

Production and exports of Russian asbestos, 1933–37, in metric tons

Year	Production	Exports	Year	Production	Exports
1933	71,700	[1] 21,458	1936	125,117	[1] 26,147
1934	92,200	[1] 33,715	1937	(2)	[3] 27,299
1935	95,500	[1] 25,109			

[1] U. S. Bureau of Foreign and Domestic Commerce, Foreign Trade Notes.
[2] Data not available.
[3] Statistics of the Foreign Trade of the U. S. S. R.

BARITE AND BARIUM PRODUCTS [1]

By BERTRAND L. JOHNSON and K. G. WARNER

SUMMARY OUTLINE

The demand for crude barite in 1938 was less than in 1937. Declines of 7 percent in production and 13 percent in sales were accompanied by a further rise in the average value of crude barite sold or used by producers (to $6.47). The increased demand for barite for use in well drilling failed to counterbalance the lessened demand for other barium products resulting from the general industrial depression. Imports of crude barite were less than half those of 1937, while the average declared value of the imported barite rose over a dollar a ton. Total sales of barium products were only slightly less in 1938 than in 1937, but the value was more than 2 million dollars lower owing largely to the slump in sales of lithopone and blanc fixe. The quantity of ground barite sold or used by producers increased markedly because of the demand from the petroleum industry, but sales of other barium chemicals, except the dioxide and hydroxide, decreased.

Salient statistics of the barite and barium products industries in the United States, 1934–38

	1934	1935	1936	1937	1938
Crude barite:					
Produced ____ short tons	178, 361	218, 075	274, 062	360, 877	335, 433
Sold or used by producers:					
Short tons	209, 850	225, 111	283, 160	355, 888	309, 663
Value: [1]					
Total	$1, 109, 378	$1, 251, 268	$1, 674, 631	[2] $2, 240, 970	$2, 004, 521
Average	$5. 29	$5. 56	$5. 91	[2] $6. 30	$6. 47
Imports for consumption:					
Short tons	40, 031	47, 048	33, 843	64, 992	24, 845
Value: [3]					
Total	$174, 937	$246, 254	$170, 316	$327, 224	$151, 235
Average	$4. 37	$5. 23	$5. 03	$5. 03	$6. 09
Apparent new supply [4] ____ short tons	249, 881	272, 159	317, 003	420, 880	334, 508
Domestic ____ percent	84. 0	82. 7	89. 3	84. 6	92. 6
Reported consumption (total) short tons	250, 476	290, 344	303, 449	383, 982	[5] 364, 985
Barium products:					
Sold or used by producers: [6]					
Short tons	228, 796	268, 652	263, 810	332, 185	327, 102
Value	$15, 173, 923	$16, 858, 413	$16, 299, 448	$17, 242, 511	$14, 871, 835
Imports for consumption:					
Short tons	9, 459	11, 672	11, 079	14, 419	8, 334
Value	$375, 262	$404, 601	$411, 797	$485, 520	$313, 902
Exports of lithopone:					
Short tons	2, 401	2, 372	2, 538	2, 671	1, 734
Value	$199, 508	$221, 611	$229, 942	$231, 622	$153, 567

[1] F. o. b. mine shipping point.
[2] Revised figures.
[3] Declared value f. o. b. foreign market.
[4] Barite sold or used by producers plus imports.
[5] Includes 7,121 short tons of crushed barite used in the glass industry.
[6] 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.

[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.

CRUDE BARITE

Production.—Barite-mining operations were in progress in 1938 in nine States—Arizona, California, Georgia, Missouri, Nevada, South Carolina, Tennessee, Texas, and Virginia. Arizona and South Carolina produced barite in 1938 but not in 1937. Mine production in 1938 totaled 335,433 short tons, a decrease of 7 percent from 1937 (360,877 tons).

Sales.—After increasing nearly 73,000 tons from 1936 to 1937, the quantity of crude barite sold or used by producers fell in 1938 more than 46,000 tons from the 1937 levels (see fig. 1), and the value decreased $236,449. The average value per ton of domestic sales rose from $6.30 (revised figure) to $6.47 in 1938 (see fig. 2), continuing the rise from the low 1933 level and bringing it up nearly to the 1930 level.

Missouri, as usual, was the leading State in sales of barite, with Georgia second, but both reported decreases in 1938 from 1937.

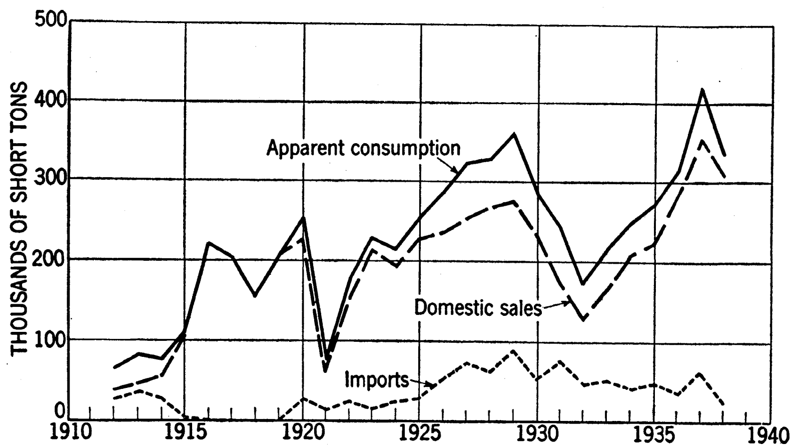

FIGURE 1.—Trends in domestic sales, imports, and apparent consumption of crude barite, 1912–38.

Sales were made by the same States in 1938 as in 1937, with the addition of Arizona and South Carolina and the elimination of Virginia. All the barite mined in Virginia in 1938 went into stocks.

Crude barite sold or used by producers in the United States, 1937–38, by States

State	1937		1938	
	Short tons	Value	Short tons	Value
Georgia	71,944	[1] $400,687	64,304	$315,329
Missouri	198,101	1,430,397	156,539	1,150,630
Other States [2]	85,843	409,886	88,820	538,562
	355,888	[1] 2,240,970	309,663	2,004,521

[1] Revised figures.
[2] 1937: California, Nevada, Tennessee, Texas, and Virginia; 1938: Arizona, California, Nevada, South Carolina, Tennessee, and Texas.

Prices.—The market quotation for crude barite from Georgia, f. o. b. mines, according to the Engineering and Mining Journal Metal and Mineral Markets, has remained unchanged at $7 per short ton from 1935 to 1938, inclusive. Missouri crude (93 percent barium sulfate, less than 1 percent iron) was quoted at \$7.50 per short ton and crude barite (minimum 90 percent $BaSO_4$) at \$6 to \$6.50 f. o. b. mines in 1938. The average value, f. o. b. mine shipping point, of crude barite for the entire United States, as calculated from reports by producers to the Bureau of Mines, increased from \$6.30 (revised figure) in 1937 to \$6.47 in 1938.

Consumption by uses.—The consumption of crude barite (domestic and imported) in 1938 by manufacturers of barium products in the

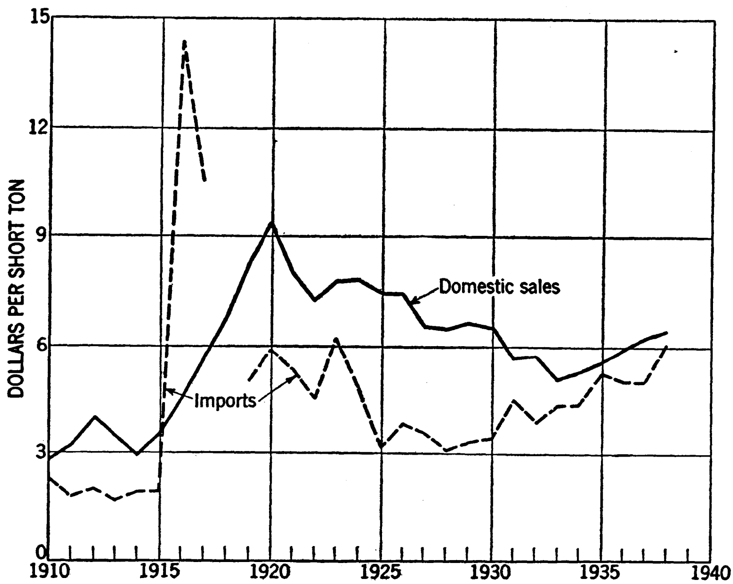

FIGURE 2.—Average value of domestic crude barite sold or used by producers and crude barite imported, 1910–38.

United States was about 19,000 tons less than in 1937, owing to large declines in the quantities of barite used in the manufacture of lithopone and barium chemicals that more than counterbalanced the large increase in the demand for ground barite. The upward trend in the quantity of crude barite used in the production of ground barite continued in 1938, with an increase of nearly 38,000 tons to a record total of 186,607 short tons. For the first time since 1916 more crude barite was used in the production of ground barite than in the production of lithopone. The quantity of crude barite consumed in lithopone production was less in 1938 than in any year since 1922.

Crude barite (domestic and imported) used in the manufacture of barium products in the United States, 1934–38, in short tons

Year	In manufacture of—			Total	Year	In manufacture of—			Total
	Ground barite	Lithopone	Barium chemicals			Ground barite	Lithopone	Barium chemicals	
1934	61,123	140,734	48,619	250,476	1937	148,930	162,681	72,371	383,982
1935	93,692	146,164	50,488	290,344	1938	186,607	117,007	54,250	[1] 364,985
1936	83,990	167,014	52,445	303,449					

[1] Includes 7,121 short tons of crushed barite used in the glass industry.

Consumption by States.—Thirty-four plants in 13 States processed crude barite in 1938 compared with 31 plants in 12 States in 1937, producing ground barite, lithopone, and barium chemicals. The additional operations were in California (2), Missouri (1), and Rhode Island (1). One less plant operated in New York in 1938 than in 1937. These markets for crude barite lie in three general areas—the eastern or Atlantic Coast region, the midwestern or Mississippi Valley region, and the western or Pacific Coast region. The eastern and midwestern markets are by far the most important, each consuming 100,000 to 200,000 tons annually, whereas the western market consumes less than 60,000 tons. In 1938 a greater tonnage of crude barite was processed in the midwestern area than in the eastern, the Pacific Coast area still ranking third. Imports are confined largely to the Atlantic seaboard.

Crude barite (domestic and imported) used in the manufacture of barium products in the United States in 1938, by States

State	Product manufactured	Plants	Barite used (short tons)
Missouri	Ground barite and chemicals	5	122,921
Delaware, New Jersey, and Pennsylvania	Lithopone and chemicals	5	70,123
California	Ground barite, lithopone, and chemicals	8	57,930
Illinois	do	6	39,177
Rhode Island	Chemicals	1	67,713
West Virginia	do	2	
Kansas	Lithopone	1	
Maryland	do	1	
Georgia	Ground barite and chemicals	2	
New York	do	2	
South Carolina	Ground barite	1	
		[1] 34	[2] 364,985

[1] A plant producing more than 1 product is counted but once in arriving at State totals.
[2] Includes 7,121 short tons of crushed barite used in the glass industry.

Deposits.—Several articles describing the barite deposits of Georgia, Tennessee, Virginia, and California were published in 1938.

The Cartersville barite district of Georgia was described by Kesler [2] and Hale.[3] Cartersville, the commercial center of the district, is on the western margin of a northeasterly trending mineralized belt 18 miles long by 2 miles wide. Crystalline barite of hydrothermal origin occurs in the highly fractured metamorphosed Shady dolomitic limestone of Lower Cambrian age. It fills fissures and forms irregular bodies, probably by replacement of the limestone. The Lower Cambrian rocks were folded and converted to low-grade metamorphic rocks during Appalachian mountain building near the end of Paleozoic time. Subsequently pegmatites were intruded, and hydrothermal solutions formed the mineral deposits of the district. Weathering of the dolomite by meteoric agencies followed the removal of the overlying rocks after Paleozoic times, and the commercial deposits of barite, rather definitely localized, occur in the residuum.

[2] Kesler, T. L., Sienna ("Ocher") Deposits of the Cartersville District, Ga.: Econ. Geol., vol. 34, No. 3, May 1939, pp. 324–341.
[3] Hale, D. P., Jr., Modern Mining and Beneficiation of Barite at Cartersville, Ga.: Am. Inst. Min. and Met. Eng. Tech. Pub. 973, 1938, 13 pp.

The barite deposits of Tennessee were discussed in several articles [4] in 1938. Tennessee has two important barite-producing areas—the Sweetwater district in eastern Tennessee and the Pall Mall district in central Tennessee. In the Sweetwater district the commercial barite deposits occur as lumps and masses of barite in the residual clays overlying the Knox (Cambro-Ordovician) dolomite, the barite being derived from the weathering of barite-bearing veins in the dolomite. In the Pall Mall district the commercial ores occur in the residual clays derived from the underlying upper Mississippian limestone.

Edmundson [5] described in detail the numerous barite deposits of Virginia. The barite occurs in fissure veins, replacement masses, breccia zones, and residual deposits. The wall rocks of the deposits include pre-Cambrian marble, schist, and gneiss; Paleozoic limestone and dolomite; and Triassic shale, sandstone, and diabase. Many of the deposits extend to a depth of 150 feet. The barite is believed by Edmundson to have been formed by rising solutions of magmatic origin. It is not thought that all the barite deposits were formed at the same time, but it is believed that the mineralization took place after the Appalachian revolution and may be related to Triassic igneous activity.

The occurrence of barite in California was described by Pabst.[6]

Technology.—The technologic treatment of various eastern and midwestern barite ores is discussed in recent reports.[7]

Foreign trade.—A considerable tonnage of crude barite is imported annually into Atlantic coast ports. The general trend of these imports since 1929 has been downward (see fig. 1), accompanied by a rise in average value that in 1938 reached $6.09 per ton (see fig. 2). All imports in 1938 (only 38 percent of those in 1937) were of German and Cuban barite, and although nearly five times as much barite entered from Cuba in 1938 as in 1937 the great decrease in imports from Germany lowered the total sharply. In 1938, 74 percent of the imports originated in Germany (partly transshipped from the Netherlands) and the rest in Cuba. Total imports of crude barite were the smallest since 1924.

Barite deposits in the Province of Pinar del Rio, Cuba, were worked during 1937 to supply demand in the United States, which did not, however, become as important as was anticipated. Exploitation of these deposits stimulated interest in other deposits of barite, but owing to lack of demand no additional production is known to have resulted.[8] No data are available regarding developments in 1938.

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[4] Whitlatch, G. I., Barite: Tennessee Dept. of Conservation, Div. Geol., Markets Circ. 7, 2d ed., Nashville, Tenn., 1938, 25 pp.
Penhallegon, W. J., Barite in the Tennessee Valley Region: Tennessee Valley Authority, Water Control Planning Dept., Geol. Div., Knoxville, Tenn., June 1938, 47 pp.
Laurence, R. A., Origin of the Sweetwater (Tenn.), Barite Deposits: Econ. Geol., vol. 34, No. 2, March-April 1939, pp. 190-200; Black Barite Deposits in Upper East Tennessee: Jour. Tennessee Acad. Sci., vol. 13, No. 3, July 1938, pp. 192-197.
Rankin, H. S., Laurence, R. A., Davis, F. A. W., Houston, E. C., and McMurray, L. L., Concentration Tests on Tennessee Valley Barite: Am. Inst. Min. and Met. Eng. Tech. Pub. 880, Min. Technol., March 1938. 13 pp.

[5] Edmundson, R. S., Barite Deposits of Virginia: Virginia Geol. Survey Bull. 53, 1938, 85 pp.

[6] Pabst, Adolf, Minerals of California: California Dept. Natural Resources, Div. Mines Bull. 113, 1938, 344 pp. (See pp. 172-175.)

[7] Hale, D. P., Jr., work cited in footnote 3.
Whitlatch, G. I., work cited in footnote 4.
Penhallegon, W. J., work cited in footnote 4.
Rankin, H. S., and others, work cited in footnote 4.
Edmundson, R. S., work cited in footnote 5.
Lieberman, H. R., Les Miserables in Missouri: Ken, Mar. 9, 1939, pp. 26-27, 47-49.
O'Meara, G., and Coe, G. D., Concentration of Southern Barite Ores: Bureau of Mines Rept. of Investigations 3376, 1938, 12 pp.

[8] Tewell, H. S., American consul, Habana, Cuba, Cuban Mineral Production in 1937: Consular Rept. Mar. 16, 1938, 8 pp.

Crude barite imported for consumption in the United States, 1937–38, by countries

Country	1937		1938	
	Short tons	Value	Short tons	Value
Cuba	1,345	$6,298	6,367	$27,578
Germany	16,099	62,605	4,200	27,188
Greece	9,026	52,057		
Italy	204	1,832	--------	--------
Netherlands	38,301	204,298	14,278	96,469
Yugoslavia	17	134	--------	--------
	64,992	327,224	24,845	151,235

Exports of crude barite from the United States are not separately recorded.

World production.—Barite is produced in many countries. Germany and the United States are by far the outstanding producers. In 1937 the United Kingdom, Italy, Greece, and France ranked next in order of output.

World production of barite, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
Algeria	--------	--------	--------	2,137	(1)
Australia:					
New South Wales	187	207	149	268	(1)
South Australia	2,345	2,378	2,009	2,736	2,909
Tasmania	--------	--------	34	77	(1)
Victoria	--------	--------	--------	71	(1)
Brazil (exports)	--------	--------	--------	600	(1)
China	9,500	(1)	(1)	(1)	(1)
Chosen	5,935	11,027	5,113	8,400	(1)
Cuba	--------	--------	--------	3,849	--------
Czechoslovakia	2,094	(1)	(1)	(1)	(1)
Egypt	50	85	30	51	(1)
France	18,350	16,900	22,200	19,850	(1)
Germany:					
Austria	1,025	797	1,663	855	(1)
Baden	19,681	12,445	17,800	21,653	(1)
Bavaria	8,385	7,073	11,175	11,832	(1)
Prussia [2]	326,318	326,950	392,103	410,634	(1)
Saxony	484	222	467	432	(1)
Thuringia	(1)	554	450	6,790	(1)
Württemburg	(1)	(1)	1,000	192	(1)
Greece	7,853	23,091	31,336	39,343	(1)
India, British	3,874	5,581	5,196	15,941	(1)
Indochina	--------	--------	40	45	(1)
Italy	32,408	41,152	36,671	45,202	(1)
Japan	--------	--------	3,837	(1)	(1)
Norway	--------	--------	408	70	(1)
Portugal	1	--------	10	101	24
Southern Rhodesia	14	--------	--------	--------	91
Spain	17,528	(1)	(1)	(1)	(1)
Union of South Africa	1,732	627	583	570	410
U. S. S. R.	74,800	(1)	(1)	(1)	(1)
United Kingdom	75,182	79,386	74,242	74,485	77,525
United States	161,806	197,833	248,624	327,380	304,298

[1] Data not available.
[2] Official figures which, it is reported, cover only output of mines included under the mining law.

Germany [9] is the leading world producer of barite, furnishing about one-half of the total world output. The principal barite deposits are at Bad Lauterberg on the southern rim of the Harz Mountains massif. One-half the German barite production comes

[9] Redecker, S. B., American consul, Frankfurt-am-Main, Germany, German Production of Barium Materials: Consular Rept., Mar. 21, 1930, 8 pp.

from this region. Another leading center of production is Nordhausen in the Harz Mountains. Germany's consumption of barite has expanded markedly in recent years as a result of heavily increased demand for barite and its derivatives in the manufacture of pigments, paints, ceramics, waterproofing and softening agents, explosives, paper, rubber goods, and other commodities. Domestic consumption of barite in pigments has increased in recent years because of official requirements for mixing the cheaper and abundantly available barium sulfate with red lead, of which there has been a shortage in Germany, and thus extending the supplies of red lead.

In international barite trade Germany holds an even more important position than in barite production, as over half of the large German production is exported. Germany likewise has an extensive foreign trade in barium chemicals, especially lithopone, blanc fixe, artificial barium carbonate, barium chloride, and barium nitrate. Germany's export trade in barite and barium materials recorded favorable development from 1935 to 1937, but a considerable recession occurred in 1938.

BARIUM PRODUCTS

Sales.—Because of the increased demand from the petroleum well-drilling industry, sales of ground barite were much greater in 1938 than in 1937. Sales of lithopone, blanc fixe, and artificial barium carbonate followed the general industrial decline and decreased in 1938; however, sales of other barium chemicals increased. Detailed statistics of sales 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, 1934–38 [1]

Product	1934	1935	1936	1937	1938
Ground barite:					
Plants	13	11	13	12	14
Short tons	53,326	76,250	69,102	129,777	[2] 161,422
Value	$1,006,905	$1,407,787	$1,217,818	$2,249,612	[2] $2,786,823
Lithopone:					
Plants	11	11	11	11	11
Short tons	145,565	159,486	158,319	154,771	125,746
Value	$12,235,624	$13,470,274	$12,976,754	$12,069,790	$9,975,012
Blanc fixe (precipitated barium sulfate):					
Plants	6	6	6	7	7
Short tons	18,115	18,067	16,149	28,250	19,428
Value	$1,084,733	$980,191	$890,310	$1,614,764	$921,203
Artificial barium carbonate (chemically precipitated):					
Plants	4	3	3	3	4
Short tons	4,706	7,329	11,347	10,755	9,543
Value	$245,315	$357,585	$515,624	$511,357	$459,901
Other barium chemicals: [3]					
Plants	7	5	7	6	5
Short tons	7,084	7,520	8,893	8,632	10,963
Value	$601,346	$642,576	$698,942	$796,988	$728,896
Total barium products:					
Short tons	228,796	268,652	263,810	332,185	327,102
Value	$15,173,923	$16,858,413	$16,299,448	$17,242,511	$14,871,835

[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 used in the glass industry.
[3] Figures cover chemicals, in order of value, as follows—1934-35 and 1937: Chloride, dioxide, sulfide, and hydroxide; 1936 and 1938: Chloride, dioxide, sulfide, hydroxide, and oxide.

Lithopone is the most important single chemical made from barium sulfide. The combination of solutions of barium sulfide and zinc sulfate yields lithopone as a white intimate mixture or coprecipitate of zinc sulfide and barium sulfate. Lithopone is used principally in the paint industry. (See fig. 3.) Sales for this purpose constituted over 81 percent of the total sales in 1938. Smaller quantities are consumed

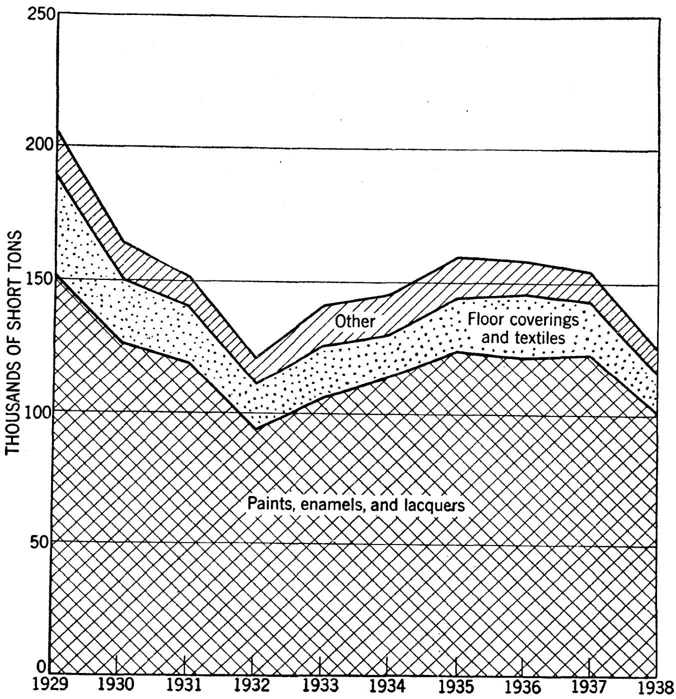

FIGURE 3.—Lithopone sold or used by producers, 1929–38, by consuming industries.

by the floor covering, textiles, and rubber industries. Sales of lithopone for all major uses decreased in 1938.

Lithopone sold or used by producers, 1936–38, by consuming industries

Industry	1936		1937		1938	
	Short tons	Percent of total	Short tons	Percent of total	Short tons	Percent of total
Paints, enamels, and lacquers	122,461	77.3	122,915	79.4	101,924	81.1
Floor coverings and textiles	23,085	14.6	20,194	13.1	15,400	12.2
Rubber	4,908	3.1	4,383	2.8	3,148	2.5
Other	7,865	5.0	7,279	4.7	5,274	4.2
	158,319	100.0	154,771	100.0	125,746	100.0

Prices.—Quotations for ground barite were the same in 1938 as in 1937. For ground witherite, however, prices were down somewhat from 1937, although those for precipitated barium carbonate were unchanged. Lithopone quotations showed slightly lower limits, in most instances one-eighth cent less. Lower prices also were quoted for barium nitrate. Prices for barium chloride had a smaller range, the lowest price quoted during 1938 being $77 compared with $74 in 1937. Details are given in the accompanying table, quotations being taken entirely from Chemical Industries.

Range of quotations on barium products, 1936–38 [1]

	1936	1937	1938
Ground barite, carlots, 350-pound barrels, works short ton	\$23.65 –\$31.15	\$23.65	\$23.65
Ground witherite, carlots, bags, works [2] do	42.00 – 45.00	\$42.00 – 45.00	\$41.00 – 44.00
Lithopone:			
Domestic, ordinary, delivered, bags pound	.04¼– .04¾	.04¼– .04⅝	.04⅛– .04⅝
Do barrels do	.04½– .05	.04½– .04⅞	.04⅜– .04⅞
High strength, bags do	.05¾– .06¼	.05¾– .06⅛	.05⅝– .06⅛
Do barrels do	.06 – .06½	.06 – .06⅜	.05⅞– .06⅜
Titanated, bags do	.05¾– .06¼	.05¾– .06⅛	.05⅝– .06⅛
Do barrels do	.06 – .06½	.06 – .06⅜	.05⅞– .06⅜
Barium carbonate, precipitated, 200-pound bags, works short ton	56.50 – 61.00	52.50 – 62.50	52.50 – 62.50
Barium chlorate, 112-pound kegs, New York pound	.15½– .17½	.16½– .17½	.16½– .17½
Barium chloride, barrels, delivered zone 1 short ton	72.00 – 74.00	74.00 – 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	.05¼– .06	.04¾– .05½	.04¾– .05½
Barium nitrate, barrels do	.07 – .08¼	.07 – .08¼	.06¾– .08¼
Barium sulfate, precipitated (blanc fixe), 400-pound barrels, works short ton	[3] 42.50 – 70.00	[3] 40.00 – 75.00	[3] 40.00 – 75.00

[1] Chemical Industries (formerly Chemical Markets), New York (monthly).
[2] 90 percent.
[3] Lowest price for pulp grade, highest for high-grade precipitated.

Preparation and uses.—Crude barite ($BaSO_4$) is the raw material used in the preparation of most barium products. The treatment accorded to the barite in the manufacture of these various barium compounds is either (1) physical—grinding and refining for the production of crushed or ground barite —or (2) chemical—the furnace reduction of the barite with carbon, leaching of the "black ash" produced, and recovery of barium sulfide solution, which is used as the base for the preparation of various other barium chemicals, such as the sulfate, carbonate, chloride, and oxide.

Ground barite is used principally as a heavy medium in mud in the drilling of deep oil wells where high gas pressures are encountered. This use took nearly 80 percent of the total sales of ground barite in 1938. No other use takes over 5 percent of the total sales. The accompanying table shows the quantity and percentages of ground or refined barite sold or used by producers in 1938 by consuming industries; these data are available this year for the first time. Another important barium chemical is precipitated barium sulfate, known commercially as "blanc fixe." It is a very fine grained white powder, ordinarily prepared from a solution of barium sulfide by the addition of sodium sulfate (salt cake) but also obtained as a byproduct in the manufacture of hydrogen peroxide by the use of barium peroxide. Witherite, natural barium carbonate, is sometimes the raw material for its preparation. Blanc fixe is used as a filler, as a pigment in paints, in cosmetics, in paper manufacture, and for barium meals in X-ray photography.

Ground or refined barite sold or used by producers in 1938, by consuming industries

Industry	Short tons	Percent of total	Industry	Short tons	Percent of total
Well drilling	126,697	79	Other [1]	13,576	8
Paint	8,227	5	Not reported	2,015	1
Glass	[2] 7,963	5			
Rubber	2,944	2		[2] 161,422	100

[1] Includes barite used in making paper, oilcloth, linoleum, cloth, and sugar, as well as minor quantities used in other industries.
[2] Includes some crushed barite used in the glass industry.

The following list includes producers of blanc fixe reporting production to the Bureau of Mines in 1938:

Barium Products Co. Ltd., Modesto, Calif.
Barium Reduction Corporation, South Charleston, W. Va.
E. I. du Pont de Nemours & Co., Room 10032, du Pont Building, Wilmington, Del.
Hercules Powder Co., Providence Drysalters Division, Wilmington, Del.
National Lead Co., Titanium Division, 111 Broadway, New York, N. Y.
Oakland Chemical Co., 59 Fourth Avenue, New York, N. Y.
Standard Ultramarine Co., Huntington, W. Va.

Foreign trade.—Imports of all classes of barium compounds for consumption in the United States in 1938 decreased both in quantity and value from 1937, except "barium compounds not elsewhere specified." Less than half the quantity of witherite was imported in 1938 as in 1937.

Barium compounds imported for consumption in the United States, 1934–38

[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
1934	1,863	$16,916	3,927	$219,752	370	$58	459	$26,156		
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	207,115	100	13	106	5,102	(1)	32

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
1934	2,358	$43,808	107	$4,808	454	$44,884	287	$17,548	132	$66	4	$1,266
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

[1] 110 pounds.

Both the quantity and value of exports of lithopone in 1938 were less than in any year since 1933.

Lithopone exported from the United States, 1934–38

Year	Short tons	Value		Year	Short tons	Value	
		Total	Average			Total	Average
1934	2,401	$199,508	$83.09	1937	2,671	$231,622	$86.72
1935	2,372	221,611	93.43	1938	1,734	153,567	88.56
1936	2,538	229,942	90.60				

POTASH

By J. H. Hedges

SUMMARY OUTLINE

Producers in the United States made and sold more potash salts in 1938 than ever before, although both domestic consumption and exports receded from the 1937 peak. Imports dropped 45 percent to 193,609 tons K_2O in 1938 from 351,445 tons K_2O in 1937, but importers appear to have withdrawn about 96,000 tons of salts equivalent to around 40,000 tons of K_2O from stocks accumulated in 1937. Domestic producers supplied about 52 percent of the 467,000 tons of potash (K_2O) that moved from primary sources into domestic channels for consumption.

Domestic output rose 11 percent in 1938 to 534,945 short tons of salts equivalent to 316,951 tons of K_2O from 486,090 tons equivalent to 284,497 tons of K_2O in 1937. The average grade was 59.2 percent K_2O in 1938 compared with 58.5 percent in 1937. Production exceeded sales by more than 30,000 tons of potash, and producers' stocks were correspondingly increased, the year-end carry-over rising to 87,000 tons of K_2O.

Producers sales expanded 7 percent to 286,437 tons of potash in 1938 from 266,938 in 1937, notwithstanding a drop of around 10,000 tons in domestic consumption, and the value at the plant increased to $9,748,290 compared with $9,019,534 in 1937. The 1938 average value of $19.57 per ton was 25 cents more than the 1937 average.

Estimates of consumption based on sales reported for 1938 are not directly comparable with the corresponding figures for 1937 because final delivery dates on orders placed with the principal producers and importers during the discount periods were advanced in 1938 to December 31, whereas 1937 contracts called for delivery in approximately equal monthly installments to January 31, 1938. Hence, 1938 sales and consumption figures might be considered to represent 13 months' business if calculated on the same basis as those for 1937. If the custom of previous years had been followed 20,000 to 30,000 tons of potash might have been delivered in January 1939 on 1938 contracts and would then have been reported as 1939 sales. Therefore, for the purpose of comparing the use of potash in agriculture and industry in 1938 with that in 1937, the 1938 consumption probably should be estimated at around 440,000 tons, although producers and importers actually delivered 467,000 tons to buyers for manufacture into fertilizer and other minor uses. The decline in fertilizer sales reported by the National Fertilizer Association—from 8,195,000 tons in 1937 to 7,504,000 tons in 1938—would indicate a shrinkage of 35,000 to 40,000 tons in the amount of potash consumed on American farms.

The effect of completing deliveries on 1938 contracts within the calendar year is evident also in the 40,000-ton drop in deliveries reported by the American Potash Institute for the first quarter of 1939 compared with the corresponding period of 1938.

Output of the American Potash & Chemical Corporation at Trona, Calif., and that of the United States Potash Co. and of the Potash Co. of America near Carlsbad, N. Mex., comprised over 98 percent of the total production. The California company extracts potash and other salts from the brine of Searles Lake, and at the two New Mexico operations sylvinite is mined from a depth of about 1,000 feet and refined at nearby plants. Small shipments of crude minerals from various operations in Utah and Wyoming contributed unimportant amounts to the total, and a few thousand tons of potash-bearing material was recovered from distillery waste and cement flue dust. Bonneville, Ltd., a Salt Lake corporation operating near Wendover, Utah, began in July small but steady shipments of muriate extracted from the brines of Salduro marsh, by methods recently developed.

Imports were mainly of German and French origin, although increased shipments were received from Palestine and Spain, and importation of crude saltpeter from Chile continued. It is doubtful whether the Spanish mines were worked at all during 1938, and shipments by the Loyalist Government probably came from stocks at Barcelona. Following the victory of the Nationalist forces under General Franco the return of the potash mines to their owners is anticipated, and production and export doubtless will be resumed under the old arrangement with the International Cartel.

The decrease in exports from approximately 62,000 tons of potash in 1937 to 51,800 tons in 1938 was explained by the decline in shipments to Japan that was only partly offset by larger sales to Belgium and Norway. About 16,000 tons of salts containing nearly 10,000 tons of potash represented resales by customers of producers and importers. The economic situation in Japan may result in further curtailment of sales to that country, which in 1938 maintained its position as America's best customer for potash in spite of reduced imports.

The Potash Export Association, Inc., organized by American Potash & Chemical Corporation, United States Potash Co., and Potash Co. of America, to handle their export sales, filed a statement in December with the Federal Trade Commission, under the Webb-Pomerene Export Trade Act of 1918, setting forth its place of business, officers, and members and declaring its purpose to engage in exporting potash salts. This act exempts from antitrust laws associations entered into for the sole purpose of engaging in export trade "provided such association, agreement, or act is not in restraint of trade within the United States, and is not in restraint of the export trade of any domestic competitor of such association."

Salient statistics of the domestic potash industry for 1937 and 1938 are summarized in the following table:

Salient statistics of the potash (crude and refined potash materials) industry in the United States, 1937–38

	1937	1938
Production:		
Potassium salts short tons	486,090	534,945
Approximate equivalent, K_2O do	284,497	316,951
Sales:		
Potassium salts do	466,933	498,189
Approximate equivalent, K_2O do	266,938	286,437
Value at plant	$9,019,534	$9,748,290
Average per ton	$19.32	$19.57
Imports:		
Crude and refined short tons	810,529	450,387
Approximate equivalent, K_2O do	351,445	193,609
Value	$19,733,076	$13,512,110
Exports:		
Fertilizer materials short tons	103,031	84,137
Approximate equivalent, K_2O do	61,000	50,500
Value	$3,278,895	$2,599,772
Other short tons	2,094	2,616
Approximate equivalent, K_2O do	1,000	1,300
Value	$484,450	$485,672

PRICES

Except for shortening to December 31 the delivery period on orders subject to the published discounts, schedules of prices issued by producers and importers in May 1938 were virtually identical with those of the year before. Muriate was quoted at 53½ cents per unit of K_2O, 30-percent manure salts at 58½ cents, 20-percent kainite at $12.75 per ton in bulk, sulfate of potash (90-percent K_2SO_4) at $38 per ton in bags, and sulfate of potash-magnesia (48-percent K_2SO_4) at $25.75 per ton in bags. As usual, prices were guaranteed against reduction. A 12-percent discount was offered on orders placed before July 1 for delivery in approximately equal monthly installments to December 31 and 5 percent on orders placed from July 1 to September 30 for delivery to December 31. On orders placed after September 30 for delivery during the remainder of the fertilizer year to May 31, 1939, prices were net.

The following table shows the monthly average prices prevailing during 1938 in accordance with published schedules:

Average prices per short ton of potash salts in 1938, 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 May	$26.75	$38.00	$25.75	$17.55	$12.75
June	23.54	33.44	22.66	15.44	11.22
July to September	25.41	36.10	24.46	16.67	12.11
October to December	26.75	38.00	25.75	17.55	12.75

CONSUMPTION AND USES

Approximately 467,000 tons of potash were sold in 1938 by producers and importers for the manufacture of mixed fertilizers and for chemical and other industrial uses in the United States. About 94 percent of the total was destined for use in agriculture. From information available to the Bureau of Mines no estimate can be made of ultimate consumption by application to the soil or utilization in industry.

The American Potash Institute reports that deliveries by member companies in the United States and its possessions in 1938 totaled 439,561 tons of potash and that 40,843 tons were exported. Importations and sales of all other primary suppliers amounted to 38,938 tons, indicating a total movement of potash of 519,342 tons from primary sources to buyers. Deducting exports of 51,800 tons leaves 467,542 tons sold for consumption in the United States. Apparent consumption calculated by subtracting exports (51,800 tons) from the sum of domestic sales (286,437 tons) and imports (193,609) was only 428,246 tons. The difference of 39,296 tons appears to have been withdrawn from previously accumulated importers' stocks. The basis of this estimate is shown in the following tabulation of deliveries by member companies of the American Potash Institute, sales by nonmember producers, entries by nonmember importers, and total exports.

Sales of primary potash for consumption and export in 1938, in short tons

	Bulk salts	Equivalent K_2O
Deliveries by member companies, as reported by American Potash Institute:		
In United States and possessions:		
Agricultural	821,406	423,977
Chemical	25,591	15,584
For export	68,116	40,843
	915,113	480,404
Imports not included above plus sales of nonmember producers	129,872	38,938
	1,044,985	519,342
Total exports	86,753	51,800
Actual sales for consumption in United States	958,232	467,542
Apparent consumption	861,823	428,246
Apparent withdrawals from importers' stocks	96,409	39,296

PRODUCTION AND SALES

The tonnage of potash in marketable salts produced by mines and plants in the United States continued the upward trend begun in 1922 from the low level of postwar liquidation. The increase of 11 percent—from 284,497 tons in 1937 to 316,951 in 1938—was only slightly less than the 13-percent gain made in 1937. Sales, however, increased only 7 percent, and about 32,000 tons were added to stocks. Value at the plant of salts sold increased \$728,756 (8 percent) to \$9,748,290. The average grade of salts produced was 59.2 percent K_2O, an increase of 0.7 percent from the 1937 average. About 52 percent of the home market was supplied by producers, and about 8.5 percent of their sales were for export.

One new source of potential importance was exploited during the year by Bonneville, Ltd., which began in July small shipments of high-grade muriate recovered from brines of the Salduro marsh at Wendover, Utah. Nearly 900,000 tons of crude salts averaging about 25 percent K_2O were mined from the bedded saline deposits in New Mexico.

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 the 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, 1934–38

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)
1934	8	275,732	144,342	8	224,875	114,122	$2,813,218	4	95,844	50,066
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

GOVERNMENT ACTIVITIES

The Senate investigation of the potash industry, started in 1936 under authority of Senate Resolution 274, 74th Congress, 2d Session and pursued spasmodically during 1937, was virtually recessed during 1938 following a 2-year extension, authorized May 18, 1938, of the time allowed the committee for completing the investigation and reporting to the Senate. The inquiry is in charge of a subcommittee of the Senate Committee on Public Lands and Surveys. It was instituted to determine whether unfair or illegal practices were being employed in the exploitation of potash resources and the extent of foreign ownership or control of American potash companies. The fact that the investigation is languishing leads to the surmise that the industry was found to be functioning reasonably well in the public interest. The three important operations afford employment at high wages to about 1,800 men and have been developed, without benefit of tariff protection, in competition with low-cost foreign producers to a degree that insures independence of foreign supplies.

Potash Reserve No. 6, New Mexico No. 1, withdrawn from entry by Executive order of March 11, 1926, and Potash Reserve No. 7, New Mexico No. 2, withdrawn by Executive order of June 8, 1929, together comprise 9,282,160 acres and include all of Lea, Roosevelt, and Curry Counties and parts of Eddy, Chavez, and De Baca Counties in southeastern New Mexico. In these areas, insofar as title remains in the United States, potassium and sodium deposits are severed from the surface and reserved to the United States, subject to lease under the mineral leasing laws. All mining operations on public land mineral leases are supervised by the Geological Survey, which is likewise charged with land classification.

Several leases were issued during the year by the Secretary of the Interior, including three to the Union Potash & Chemical Corporation, whose applications had been pending for some time.

REVIEW BY STATES

California.—Operations of the American Potash & Chemical Corporation at Trona, Calif., continued throughout the year. In addition to potash, borax, soda ash, and salt cake this company is now recovering lithium from the complex brine of Searles Lake in the form of sodium lithium phosphate containing about 22 percent lithia, which is sold to a company that supplies the trade with lithium salts for various uses. The rapid growth of air-conditioning, in which lithium chloride is used for dehumidifying the air, is fast creating a broader market for lithium salts.

Maryland.—Byproduct potash was produced by the North American Cement Corporation at Hagerstown and the United States Industrial Chemical Co. at Baltimore, the former from cement-kiln dust and the latter from distillery waste. These two companies annually supply a few thousand tons of material that is marketed as agricultural potash.

New Mexico.—Output of the two potash mines near Carlsbad in 1938 approached 900,000 tons of crude salts averaging about 25 percent K_2O—the largest mine production yet recorded. The United States Potash Co. and the Potash Co. of America are the only producers in the State. Most of their mine product is refined and sold in the form of high-purity muriate, although there is still a relatively small market for run-of-mine and mixed salts of lower analysis. First shipments from this area were made in 1931, and development since that time has been rapid.

The shaft of the Union Potash & Chemical Corporation was completed by the International Agricultural Corporation to a depth of 925 feet, and levels were opened at 787 feet and 907 feet, under an option agreement understood to involve a controlling interest in the property. Additional drilling is now in progress to explore further the three leases, aggregating 7,680 acres, that constitute the present holdings. Numerous potash-bearing beds were cut by the shaft, the more important being mixtures of langbeinite and sylvite. In this respect the deposit appears to differ from others in the district now being mined, where langbeinite is not found in important quantities.

Utah.—The early potash investigations of the Geological Survey, beginning in 1911, included a study of the brines of the Salduro marsh in western Utah, which were found to contain varying amounts of potassium chloride associated with sodium and magnesium salts. Under the stimulus of high prices created by the potash shortage during the World War plants were built to recover potash from these brines, and several thousand tons of fairly high-grade muriate were produced. However, costs were high, and when imports were resumed and prices returned to normal after the war the plants were forced to close. No potash from this source was reported after 1921. In 1938 operations in this area were resumed on a small scale by Bonneville, Ltd., following extended experimentation. The plant of this company is near Wendover, close to the Nevada line. The first shipment was made in July, and shipments continued throughout the rest of the year. Crude salts are recovered from the brine by solar evaporation and refined to produce high-grade muriate.

FOREIGN TRADE [1]

Imports.—Potash imports dropped abruptly in 1938 to 193,609 short tons, a decrease of 157,836 tons (45 percent) from the all-time peak of 351,445 tons established in 1937. Fertilizer salts contained 93 percent of the potash imported, and salts imported for use in the chemical industries the remaining 7 percent.

The quantity, average grade, and total declared value of the various potash salts imported in 1937 and 1938, the countries from which shipments were made, 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, 1937–38

Material	Approximate equivalent as potash (K_2O) (percent)	1937				1938			
		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	974	136	------	$7,238	402	56	------	$2,528
	20.0	129,051	25,810	7.4	1,131,898	59,811	11,962	6.2	523,229
Manure salts	31.4	44,909	14,101	4.0	591,804	9,169	2,879	1.5	112,713
Muriate (chloride)	56.4	417,682	235,573	67.0	9,725,200	223,542	126,078	65.1	5,371,600
Nitrate (saltpeter) (Chilean)	14.0	61,271	8,578	2.5	1,309,386	44,493	6,229	3.2	971,646
Potash - magnesia sulfate	27.0	22,375	6,041	1.7	453,026	13,158	3,553	1.8	281,691
Sulfate	50.0	93,694	46,847	13.3	2,851,880	59,855	29,928	15.5	1,910,819
Other potash fertilizer material [1]	60.0	255	153	.1	1,952	184	110	.1	1,373
Total fertilizer	-------	770,211	337,239	96.0	16,072,384	410,614	180,795	93.4	9,175,599
Used chiefly in chemical industries:									
Bicarbonate	46.0	206	95		34,467	103	47		17,334
Bitartrate:									
Argols	20.0	11,910	2,382		1,699,328	15,873	3,175		2,471,892
Cream of tartar	25.0	(2)	(2)		9	18	5		5,226
Bromide	39.6	2	1		1,008	(2)	(2)		30
Carbonate	61.0	788	481		81,234	292	178		30,981
Caustic	80.0	1,137	910		167,857	486	389		79,128
Chlorate and perchlorate	36.0	6,956	2,504		585,470	6,848	2,465		808,151
Chromate and bichromate	40.0	(2)	(2)		330	(2)	(2)		163
Cyanide	70.0	43	30	4.0	34,460	42	29	6.6	29,751
Ferricyanide (red prussiate)	42.0	189	79		89,772	98	41		42,814
Ferrocyanide (yellow prussiate)	44.0	56	25		10,949	70	31		12,780
Iodide	28.0	(2)	(2)		42	(2)	(2)		90
Nitrate:									
Crude	40.0	17,272	6,909		761,764	14,648	5,859		680,602
Refined	46.0	1,166	536		93,024	1,042	479		100,509
Permanganate	29.0	200	58		38,910	49	14		10,168
All other	50.0	393	196		62,068	204	102		46,892
Total chemical	-------	40,318	14,206	4.0	3,660,692	39,773	12,814	6.6	4,336,511
Grand total	-------	810,529	351,445	100.0	19,733,076	450,387	193,609	100.0	13,512,110

[1] Chiefly wood ashes from Canada. [2] Less than 1 ton.

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

Potash materials imported for consumption in the United States in 1938, by countries, in short tons

[Figures in parentheses in column headings indicate in percent approximate equivalent as potash (K_2O)]

Country	1938									
	Muriate (chloride) (56.4)	Sulfate (50)	Potash-magnesia sulfate (27)	Manure salts (31.4)	Kainite		Bitartrate		Caustic (80)	Carbonate (61)
					(14)	(20)	Argols or wine lees (20)	Cream of tartar (25)		
Algeria							3,525			
Argentina							828			
Belgium	9,823	2,372		404		1,281				
Bulgaria										
Canada	3,556	183	26				2			
Chile							155			
China										5
Czechoslovakia									2	
France	33,880	9,353		1,656		13,482	8,104			
Germany	110,125	39,260	13,132	4,480	402	32,188			418	215
Greece										
Hong Kong		(1)								3
Italy							2,494	18		
Japan										(1)
Morocco							134			
Netherlands	36,458	8,687		976		12,860				68
Palestine	10,256									
Portugal							387			
Spain	14,261			1,653			27			
Sweden	2								66	1
Switzerland										
Tunisia							217			
U. S. S. R.	5,181									
United Kingdom										
	223,542	59,855	13,158	9,169	402	59,811	15,873	18	486	292

Country	1938—Continued						Total 1937	
	Cyanide (70)	Nitrate (saltpeter), crude (14 and 40) [2]	Chlorate and perchlorate (36)	All other (48)	Total		Short tons	Value
					Short tons	Value		
Algeria					3,525	$500,279	1,824	$238,513
Argentina					828	50,861	601	56,900
Belgium					13,880	312,137	41,930	845,514
Bulgaria							110	20,923
Canada		588	(1)	183	4,538	129,059	7,293	210,033
Chile		44,493			44,648	998,103	61,473	1,339,560
China				1	6	856	3	439
Czechoslovakia				41	43	8,999		
France	2		214	112	66,803	2,705,481	30,508	1,345,583
Germany	40	14,060	5,411	1,251	220,982	6,140,915	535,732	12,116,306
Greece							293	37,987
Hong Kong					3	286	11	1,247
Italy					2,512	422,225	3,686	540,165
Japan			193	7	200	12,867	67	7,806
Morocco					134	15,559	46	3,265
Netherlands				104	59,153	1,291,732	114,514	2,433,183
Palestine					10,256	328,837	106	2,475
Portugal					387	51,969	286	45,827
Spain					15,941	225,774	58	6,093
Sweden			141		210	40,878	428	77,238
Switzerland			889	3	892	89,371	641	69,053
Tunisia					217	24,030	192	17,145
U. S. S. R.				25	5,206	148,838	10,693	303,429
United Kingdom				23	23	13,054	34	14,392
	42	59,141	6,848	1,750	450,387	13,512,110	810,529	19,733,076

[1] Less than 1 ton.
[2] Nitrate from Chile calculated at 14 percent K_2O, other countries 40 percent.

Approximate equivalent as potash (K_2O) *of potash-bearing materials imported for consumption in the United States, 1934–38, in short tons*

1934	171,955	1937	351,445
1935	241,510	1938	193,609
1936	211,752		

Exports.—Shipments of fertilizer salts to Japan, the largest buyer of American potash, were 28,000 tons less in 1938 than in 1937; and although exports to Canada and Europe expanded, the total was 18 percent below the 1937 figure. About 80 percent represented direct sales by producers and 10 percent resales from consumers' or speculators' stocks. Exports of chemical salts were slightly higher in 1938 than in 1937.

Potash fertilizer materials exported from the United States, 1937–38, by countries

Country	1937		1938	
	Short tons	Value	Short tons	Value
Austria	72	$2,318		
Belgium	719	26,203	13,101	$331,292
Canada	20,691	589,229	21,368	567,859
Canary Islands			560	7,500
Czechoslovakia	231	7,486		
Finland	888	28,800		
Haiti	1	65	56	1,745
Honduras	56	1,644	2	67
Italy	1,151	34,889		
Japan	63,179	2,089,445	35,045	1,221,827
Mexico	(1)	10	20	805
Mozambique	28	1,000	3	116
Netherlands	2,687	85,539	1,856	66,360
Norway	1,958	63,802	4,740	153,050
Philippine Islands			658	21,428
Sweden	7,872	241,080	4,035	136,350
Union of South Africa	1,120	35,793	248	9,693
United Kingdom	594	18,857	822	30,207
Venezuela	45	1,642	112	4,497
West Indies:				
Barbados	280	10,000	239	8,723
Cuba	1,048	27,589	1,100	32,007
Other British	283	9,091	168	6,085
Yugoslavia	110	3,516		
Other countries [2]	18	897	4	161
	103,031	3,278,895	84,137	2,599,772

[1] Less than 1 ton. [2] Includes exports of less than 10 tons.

Potassium salts (not fertilizer) exported from the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	2,121	$466,929	1937	2,094	$484,450
1935	3,641	637,473	1938	2,616	485,672
1936	2,333	487,347			

WORLD PRODUCTION

The output of potash in marketable salts increased in all the leading producing countries except Spain in 1938. As already stated, shipments from Spain by the Loyalist Government are considered to have been drawn from stocks at Barcelona and not to represent new production. Although no authentic information is available it is believed that the Spanish mines, which were in Loyalist territory throughout the war, were not operated during 1938. Assuming an increase of 10,000 tons in Soviet output, world production rose 10 percent to a new high of 3,100,000 metric tons of K_2O in crude and refined salts of marketable grade. The following table is based on estimates and available information from official and unofficial sources.

Approximate world production of potash in marketable salts, 1937–38, by countries

Country	1937		1938	
	Metric tons K_2O	Percent of total	Metric tons K_2O	Percent of total
Germany	1, 689, 500	60. 6	1, 860, 000	59. 9
France	489, 800	17. 6	581, 815	18. 7
United States	258, 090	9. 2	287, 532	9. 3
U. S. S. R.	266, 000	9. 5	275, 000	8. 8
Poland	62, 489	2. 2	72, 139	2. 3
Palestine	18, 234	. 7	24, 000	. 8
Other countries	5, 000	. 2	5, 000	. 2
	2, 789, 000	100. 0	3, 105, 500	100. 0

Available official figures of world production 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	368, 880	2, 383, 494	489, 781	3, 374, 801	581, 815
Germany, crude potassium salts:								
Carnallite [3]	1, 371, 604	139, 057	1, 415, 731	145, 160	1, 672, 417	170, 550	([4])	([4])
Kainite, sylvinite, and hartsalz	10, 300, 905	1, 457, 915	10, 348, 821	1, 477, 490	12, 787, 735	1, 797, 866	([4])	([4])
Italy, alunite	2, 092	251	3, 976	477	3, 500	420	([4])	([4])
Poland, crude potassium salts:								
Kainite	81, 593	8, 159	89, 187	8, 919	111, 357	11, 136	547, 467	106, 028
Sylvite	288, 091	63, 380	336, 317	73, 990	395, 885	87, 095		
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	8, 900	4, 200	([4])	([4])
Palestine, crude potassium salts [7]	17, 201	8, 601	23, 456	11, 727	36, 467	18, 234	[8] 47, 496	24, 000
Africa: Eritrea, niccoli salts [9]	----------	----------	300	80	([4])	([4])	([4])	([4])
Australia, alunite	579	([4])	758	([4])	339	([4])	([4])	([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] Exports of muriate of potash.
Extracted from waters of the Red Sea.

FOREIGN DEVELOPMENTS

British India.—The American trade commissioner at Calcutta reports that the domestic production of potassium nitrate in British India was affected adversely by unfavorable weather and floods. Higher prices demanded caused substitution by consumers of synthetic nitrates, and exports fell to 7,387 tons from 8,357 tons in 1937.

France.—Output of crude salts from the French mines established a new record of 3,375,000 tons in 1938 that exceeded by 241,000 tons the previous record made in 1930. Sales also were greater than ever before, but because of the increased home demand producers were unable to supply their full export quota established by the International Cartel. Domestic prices have not been changed for a number of years, while costs have advanced because of social legislation and a generally rising commodity price level until there is little profit in domestic sales. The obligation to satisfy home demands before selling for export has prevented producers from taking full advantage of exchange conditions prevailing in other markets owing to depreciation of the franc. Sales in France are reported to have exceeded exports by about 18 percent. The potash mines are subject to Government control through the common sales agency established by the law of January 23, 1937, which has sole right of sale both at home and for export.

Germany.—More than 15,000,000 tons of crude potash salts averaging around 13.8 percent K_2O were mined by German producers in 1938, the greatest mine output ever recorded in the history of the industry. The percentage of mine output sold as mined or mixed with refined salts to produce intermediate grades has been decreasing in recent years in line with the trend toward high-analysis fertilizers. From 85 to 90 percent is processed to produce muriate, sulfate, and other of the higher-grade salts to which market demand has shifted. In 1938 the mine output of approximately 15,000,000 tons was converted into 5,190,000 tons of salts of all marketable grades averaging 35.8 percent potash, equivalent to 1,860,000 tons of K_2O.

Mine output and marketable salts produced from 1932 to 1938 are stated in the following table.

Production of potash salts in Germany, 1932–38

[Thousands of metric tons]

Year	Salts mined		Marketable salts produced	
	Gross weight	Equivalent K_2O	Gross weight	Equivalent K_2O
1932	6,416	871	2,801	787
1933	7,363	1,026	3,131	906
1934	9,617	1,329	4,175	1,179
1935	11,673	1,597	4,712	1,396
1936	11,765	1,623	4,734	1,441
1937	14,460	1,968	5,122	1,690
1938	[1] 15,300	[1] 2,114	5,190	1,860

[1] Estimated.

Under Government pressure to increase crop production and measures to cheapen the cost of fertilizers, consumption of potash by German farmers has expanded rapidly in recent years. Domestic sales rose from 620,000 metric tons of K_2O in the fertilizer year 1932–33 to 1,156,000 tons in the fertilizer year 1937–38, an increase of 86 percent in 5 years. However, Government-controlled prices have been maintained at an unprofitable level, and producers look to export business and expansion of byproduct manufacture to produce earnings for their stockholders. Notwithstanding rising sales, net profits, and dividend disbursements of the leading companies have declined steadily.

Exports in 1938 were sharply reduced from the 1937 level, owing mainly to smaller sales in two of the leading markets, the United States and Japan. Exports of raw potash salts declined only 10.5 percent to 698,546 metric tons, but exports of processed salts dropped 47 percent to 395,325 tons. The average value, in marks per metric ton, of raw salts exported rose from 39.38 in 1937 to 41.71 in 1938, but that of processed salts decreased from 68.87 in 1937 to 64.30 in 1938.

Increased demand for potash and more particularly for the processed salts has necessitated large expenditures in plant expansion and facilities for storing and handling the finished products. Wintershall A. G., the dominant factor in the potash industry that directly controlls 42 percent of the output, reports that in 1937 an investment of 31,000,000 marks was required for plant enlargement, purchase of new machinery, and plant improvements compared with 14,190,000 marks in 1936. Vice Consul G. M. Gerrity, attached to the American consulate general at Frankfort on the Main, states that the immense gains in national production of potash in recent times have resulted to only a moderate degree in increased earnings of German potash companies owing to the combined factor of heavy investments required for new plant equipment, uncertainties in the international trade and, since the spring of 1937, the Government's drastic reductions by around 25 percent of the fixed domestic prices of potash fertilizer. Thus, in spite of its heavily increased business, the Wintershall A. G. increased its net earnings only moderately in 1937—to 6,027,000 marks from 5,747,000 in 1936 and 5,710,000 marks in 1935. The company continued the 5-percent dividend upon its 125,000,000 marks of common stock, or the same rate in effect for the 2 preceding years.

The writer is indebted to American Consul Sydney B. Redecker and American Vice Consul G. M. Gerrity for general information and factual data on the German potash industry.

Japan.—According to the American commercial attaché at Tokyo, Japanese producers of potassium chlorate contend that changed conditions in China have made the international sales agreement of March 30, 1937, with European producers unworkable. The agreement, which allocated sales territories and export quotas, allotted all of Japan and Manchuria and 55 percent of the Chinese market to Japanese producers. Plans are being pushed to utilize bittern and sea water as the basis of a chemical and metallurgical industry. The production of metallic magnesium, aluminum, potassium chloride, sulfate and bromide, and ammonium sulfate is contemplated. The Japan Industrial Salt Co., Kobe Steel Manufacturing Co., and Meiji Mining Co. are interested in these projects.

Poland.—Mine production of crude potash salts in 1938 increased about 9 percent to 567,111 metric tons averaging 19 percent K_2O equivalent to 108,380 tons of potash from 521,483 tons averaging 19 percent K_2O equivalent to 99,940 tons of potash in 1937. Potash in marketable salts produced by refining and mixing the salts mined was reported to be 72,139 metric tons of K_2O in 1938 compared with 62,489 tons in 1937. Stimulated by a price cut of 9 percent, sales of potash (K_2O) rose to 71,412 metric tons in 1938 from 64,605 tons in 1937. A slight reduction in Poland's export quota by the International Cartel was reported to have caused the decrease in exports of commercial potash salts from 84,803 metric tons in 1937 to 74,570 in 1938.

MICA

By Paul M. Tyler and K. G. Warner

SUMMARY OUTLINE

World prices of mica were well-maintained in 1938 by the active foreign demand that continued almost unabated, especially in Europe; but in the United States, owing to curtailed consumption and the large stocks held by manufacturers, demand receded to depression levels. In comparison with 1937—a remarkably good year in almost every branch of the mica-manufacturing industries—1938 leaves a drab record. Domestic production of uncut mica decreased 45 percent in 1938 and of larger sheet sizes over 55 percent from the relatively high levels of the preceding year. The total yield of punch and sheet mica from American mines was less than in any but the worst years of the last three decades, amounting to only 939,507 pounds worth $139,333 compared with 1,694,538 pounds valued at $285,244 in 1937.

Domestic needs for the better qualities of mica, however, are supplied principally by imports, and the curtailed demand is shown further by the sharp reduction in receipts of foreign mica of all important kinds. Imports of sheet and block mica aggregated only 391,125 pounds with a nominal foreign market valuation of $113,403 compared with 1,004,950 pounds and $296,235 in 1937; the decrease in this category was more than 60 percent. In respect to splittings (the principal import item) the decrease was almost 75 percent, from 7,932,867 pounds valued at $1,598,969 in 1937 to 1,979,162 pounds valued at $445,323 in 1938. Domestic consumption of splittings reported to the Bureau of Mines decreased over 60 percent, and the large stocks carried over from 1937 were increased further.

Running counter to the general trend of the industry was the prosperity of the mica-grinding portion. Shipments of ground mica almost equaled the 1937 record in quantity and exceeded it by 10 percent in value. Increased demands for paint, wallpaper, and other miscellaneous uses more than offset a 13-percent reduction in the quantities used in roll roofing, which, however, took 70 percent of the total tonnage. Despite the activity of mica-grinding mills, their purchases of scrap declined in 1938, and since European buying is a minor factor in this market, prices of newly mined waste mica were greatly reduced.

The total production of uncut sheet mica and scrap in the United States was 20,727 short tons valued at $395,715 in 1938 compared with 26,043 short tons valued at $639,981 in 1937 and 21,615 tons valued at $464,473 in 1936. Imports totaled 5,761 tons, nominally valued at $664,419 on a foreign market basis; in 1937 they aggregated 11,339 tons with a declared valuation of $2,067,599 and in 1936, 6,678 tons valued at $1,205,568. The foregoing figures for domestic and imported mica, respectively, make it appear that almost four times as much mica was produced in the United States as was imported in 1938. This is true in respect to total tonnage but actually the United States seldom produces as much as one-third of its requirements of sheet mica (larger than 1½ by 2 inches) and only a negligible amount of its requirements of splittings. The bulk of the domestic output is scrap, ground mica schist, and byproduct mica, although American mines also produce almost enough punch and circle mica—used for making washers and small radio stampings—to meet domestic needs.

For many years mica has been considered one of the few materials for which no acceptable substitute was available in many of its principal uses. Recent laboratory research indicates that a product (Alsifilm) made from bentonite may compete successfully with mica in the important electrical field, if it can be produced commercially. Another challenge to sheet mica and mica splittings may come from properly processed ground mica, though this development seems to be less far advanced than Alsifilm, which may be marketed on a semicommercial scale in 1939.

Salient statistics of the mica industry in the United States, 1934–38

	1934	1935	1936	1937	1938
Domestic mica sold or used by producers:					
Total uncut sheet and punch:					
Pounds	583, 528	936, 633	1, 319, 233	1, 694, 538	939, 507
Value	$90, 268	$161, 150	$203, 879	$285, 244	$139, 333
Average per pound	$0. 15	$0. 17	$0. 15	$0. 17	$0. 15
Scrap:[1]					
Short tons	7, 719	18, 852	20, 955	25, 196	20, 257
Value	$99, 791	$243, 951	$260, 594	$354, 737	$256, 382
Average per ton	$12. 93	$12. 94	$12. 44	$14. 08	$12. 66
Total sheet and scrap:[1]					
Short tons	8, 011	19, 320	21, 615	26, 043	20, 727
Value	$190, 059	$405, 101	$464, 473	$639, 981	$395, 715
Total ground:[1]					
Short tons	9, 547	18, 323	25, 585	27, 245	27, 086
Value	$403, 330	$542, 973	$722, 416	$839, 812	$924, 554
Consumption of splittings:[2]					
Pounds	1, 763, 035	2, 532, 984	3, 518, 058	4, 347, 435	1, 667, 806
Value	$490, 148	$631, 065	$846, 393	$1, 257, 645	$612, 465
Imports for consumption:					
Unmanufactured:					
Short tons	3, 844	3, 290	4, 323	7, 226	4, 646
Value	$247, 408	$211, 556	$262, 044	$332, 590	$141, 993
Manufactured:					
Short tons	1, 272	1, 588	2, 355	4, 113	1, 115
Value	$515, 214	$696, 828	$943, 524	$1, 735, 009	$522, 426
Total imports:					
Short tons	5, 116	4, 878	6, 678	11, 339	5, 761
Value	$762, 622	$908, 384	$1, 205, 568	$2, 067, 599	$664, 419
Exports (all classes of mica):					
Short tons	1, 751	1, 499	1, 478	1, 795	1, 772
Value	$188, 525	$165, 385	$170, 011	$216, 858	$183, 889

[1] Includes byproduct mica recovered in washing kaolin and, beginning in 1935, mica recovered by milling 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.

[2] Exclusive of a nominal quantity of splittings produced in South America and the United States.

DOMESTIC PRODUCTION

Sheet mica.—Mica seems to have been the first mineral mined in North America. Thousands of tons of debris on the dumps testify to the extent of the ancient workings operated by western North Carolina aborigines. The mica ornaments left by Ohio Valley mound builders likewise confirm the importance of this mineral to primitive peoples, who prized it chiefly as a decoration and perhaps as a medicine and a charm.

The first mica mine to be operated on a commercial scale in this country was probably the Ruggles, in New Hampshire, which was opened in 1803 to provide "isinglass" for stove windows. It is said also to have furnished sheets for gunboat windows, because gunfire would shatter ordinary glass. As the demand for mica developed very slowly early production in New Hampshire was only sporadic; mining on a relatively stable basis was started in 1868 in North Carolina. Since that date the latter State ordinarily has been the leading producer, occasionally alternating with New Hampshire and possibly yielding first rank to South Dakota for a year or two.

Production statistics on mica have been published annually since 1880, when the output of American mines was 81,669 pounds valued at $127,825. After rising to 147,410 pounds worth $368,525 in 1884 it dwindled rapidly owing to the competition of Indian 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 grown to 1,423,100 pounds with a value of $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 comprises uncut sheet mica alone. Beginning with 1920 also, separate figures have been 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.

Scrap mica.—The United States probably consumes 90 percent of the scrap and waste mica used. It is the only country that has a large demand for ground mica or that has had long and successful experience in grinding mica, which is one of the most difficult minerals to grind without destroying certain of its useful properties.

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 and the annual average for the 5-year pre-war period, 1909–1913, was 4,043 tons valued at $55,296. The annual average for the predepression period, 1925–29, was 7,406 tons valued at $134,128, thus showing an increase of 85 percent in less than two decades. The actual rise was even greater, because a substantial recovery of mica from clay washing as well as production from schists had been developed. These items, amounting to 6,667 short tons valued at $111,345, were included in the statistics for 1935 when the total production of scrap, ground mica schist, and byproduct mica advanced to 18,852 tons valued at $243,951. Later figures are shown in the accompanying table.

Mica sold or used by producers in the United States, 1925–38

Year	Sheet mica						Scrap mica		Total	
	Uncut punch and circle mica		Uncut mica larger than punch and circle		Total uncut sheet mica					
	Pounds	Value	Pounds	Value	Pounds	Value	Short tons	Value	Short tons	Value
1925–29 (average)	1,433,684	$117,702	405,400	$172,679	1,839,084	$290,381	7,406	$134,128	8,326	$424,509
1930–34 (average)	589,668	25,764	153,433	69,930	743,101	95,694	7,373	98,048	7,744	193,742
1935	670,327	28,387	266,306	132,763	936,633	161,150	[1] 18,852	[1] 243,951	[1] 19,320	[1] 405,101
1936	1,018,460	48,386	300,773	155,493	1,319,233	203,879	[1] 20,955	[1] 260,594	[1] 21,615	[1] 464,473
1937:										
Connecticut	311,091	12,242	90,720	31,046	401,811	43,288	561	8,616	762	51,904
New Hampshire	195,429	8,517	39,626	11,602	235,055	20,119	306	4,397	423	24,516
North Carolina	795,684	46,688	248,644	171,488	1,044,328	218,176	[2] 12,988	[2] 209,212	[2] 13,510	[2] 427,388
Other States [3]	10,696	3,046	2,648	615	13,344	3,661	[4] 11,341	[4] 132,512	[4] 11,348	[4] 136,173
	1,312,900	70,493	381,638	214,751	1,694,538	285,244	[1] 25,196	[1] 354,737	[1] 26,043	[1] 639,981
1938:										
Connecticut	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
New Hampshire [5]	200,708	8,820	82,128	40,434	282,836	49,254	927	16,189	1,069	65,443
North Carolina	552,471	35,885	80,175	51,994	632,646	87,879	[2] 11,959	[2] 161,598	[2] 12,275	249,477
Other States [3]	20,942	861	3,083	1,339	24,025	2,200	[4] 7,371	[4] 78,595	[4] 7,383	[4] 80,795
	774,121	45,566	165,386	93,767	939,507	139,333	[1] 20,257	[1] 256,382	[1] 20,727	[1] 395,715

[1] Includes mica recovered from kaolin and 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.
[2] Includes mica recovered from kaolin and schists as follows: 1937, 5,115 short tons valued at $90,994; 1938, 3,971 tons, $64,542.
[3] 1937: Arizona, California, Colorado, Georgia, Maine, New Mexico, South Carolina, South Dakota, Utah, and Virginia. 1938: Arizona, California, Colorado, Georgia, Maine, New Mexico, South Carolina, South Dakota, Virginia, and Wyoming.
[4] Includes mica recovered from kaolin and schists as follows: 1937, 5,421 short tons valued at $58,937; 1938, 2,579 tons, $22,060.
[5] Connecticut included with New Hampshire.

Ground mica.—The earlier data for ground mica are as incomplete as those for scrap mica, in that they likewise fail to include byproduct mica and ground schist mica. Reclaimed mica from clay washing competes with dry-ground mica in the important roofing market, but because it ordinarily does not have to be ground it was excluded from the statistics until 1930. Schist mica, which was produced in fairly large amounts as early as 1923 and to some extent even earlier, was excluded until 5 years later. Beginning with 1935, however, the Bureau of Mines has reported as "ground mica" all classes of material—including wet- and dry-ground muscovite, mica recovered from clay washing, byproduct mica from kyanite or other concentrating operations, and the product of milling schists (whether muscovite, sericite, biotite, or even chlorite schist). In addition to domestic raw material several grinding plants use foreign mica, both imported mine scrap and factory scrap from the manufacture of products of imported sheet mica and splittings.

The true growth of the ground-mica industry is portrayed faithfully in the official production figures, even though they are slightly distorted for a decade or two by the aforementioned statistical details. After fluctuating for many years between 3,000 and 4,000 short tons the annual output about 1925 began to rise rapidly, reaching 18,323 tons in 1935 and continuing upward to a new all-time record of 27,245 tons valued at $839,812 in 1937.

Ground mica sold by producers in the United States, 1925–38, by methods of grinding

Year	Dry-ground		Wet-ground		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1925–29 (average)	2,436	$89,624	2,821	$301,122	5,257	$390,746
1930–34 (average)	5,967	155,471	2,517	224,838	8,484	380,309
1935	[1] 15,178	[1] 341,825	3,145	201,148	[1] 18,323	[1] 542,973
1936	[1] 20,800	[1] 457,042	4,785	265,374	[1] 25,585	[1] 722,416
1937	[1] 21,150	[1] 457,879	6,095	381,933	[1] 27,245	[1] 839,812
1938	[1] 19,757	[1] 466,959	7,329	457,595	[1] 27,086	[1] 924,554

[1] Includes mica from kaolin and schist.

Especially notable in 1938 were the substantial increases in sales of wet-ground mica for wallpaper and for paint. Although the paint industry even yet takes only 6 percent of the total sales its consumption was more than half again as large in 1938 as in 1937 and many times larger than in any year before 1936. There was an even more remarkable increase in shipments for miscellaneous uses. This category includes a considerable tonnage sold for an undisclosed "new use," but consumption for several other uses also rose sharply. These increases almost counterbalanced the 13-percent decrease in sales for roll roofing, still the principal use, and contributed to the 10-percent increase in the value of the total output.

Ground mica sold to various industries in the United States, 1937–38

Industry	1937			1938		
	Quantity		Value	Quantity		Value
	Short tons	Percent of total		Short tons	Percent of total	
Roofing [1]	21,636	79	$457,652	18,795	70	$402,671
Wall paper	2,623	10	190,127	2,926	11	232,870
Rubber	1,413	5	99,106	1,187	4	82,809
Paint	1,011	4	69,125	1,666	6	117,595
Miscellaneous [2]	562	2	23,802	2,512	9	88,609
	27,245	100	839,812	27,086	100	924,554

[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, pipe and boiler covering, coating levee mattresses, and other purposes.

Mica filler is employed principally to increase the dielectric properties of molded plastics, especially molded phenolic resins for electrical uses; it is also used in rubber. The potential use of ground mica is enormous. It may be used advantageously to the extent of 10 percent of the total pigment in paints and universal adoption by the paint industry would afford a market for as much as 100,000 tons annually. A possible competitor in this field is a new pigment developed by the Universal Insulation Co., Chicago, Ill., intermediate in composition between vermiculite and mica.

CONSUMPTION AND STOCKS OF SPLITTINGS

After expanding steadily for 5 years to an all-time record in 1937 the consumption of mica splittings contracted sharply in 1938 to 1,667,806 pounds with a value of only $612,465 compared with 4,347,435 pounds worth $1,257,645 in the preceding year. The consumption in 1938 was the smallest since 1933, but stocks in consumers' hands increased by 7 percent above the abnormally heavy inventories carried over from 1937 and at the close of the year were three times as large as at the end of 1936.

Indian muscovite splittings still constitute more than 85 percent of the total consumed; however, Madagascar splittings now represent over 10 percent and have become more than twice as important as those from Canada, which enjoyed a monopoly of the amber-mica business until about 1919. Occasional batches of splittings are reported as produced by domestic mines and trimming or sorting plants, and small amounts are made in the United States from imported mica, but the aggregate quantity of American-made splittings is virtually negligible.

Consumption and stocks of mica splittings in the United States, 1934–38, by sources, as reported by the consumers

Year	India		Canada		Madagascar		Total	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Consumption:[1]								
1934	1,423,635	$350,561	94,422	$37,903	244,978	$101,684	1,763,035	$490,148
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
Stocks in consumers' hands Dec. 31:								
1934	924,028	240,792	200,018	80,976	208,354	82,809	1,332,400	404,577
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

[1] Exclusive of a nominal quantity of splittings produced in South America and the United States.

PRICES

Mica is marketed as (1) cut or uncut block, (2) sheet, (3) splittings, and (4) wet- or dry-ground, but the value depends on the size of flat sheets into which it can be split and on whether it is clear or stained. The complexity of grading and classifying sheet mica is indicated by the fact that at least 100 distinct products can be classed as unmanufactured mica. Not only do the sheets vary enormously in size, but for each size there are at least six different qualities ranging from clear to black-stained. To attempt to report prices of all these different grades (sizes) and classes (qualities) year after year would be an endless task and one that would reveal little beyond the general trend toward relatively higher prices for smaller sizes.

Trade-journal quotations for domestic mica in 1938 were about the same as in 1937 and did not differ greatly from those reported for the latter part of 1936 and tabulated on page 1405 of Minerals Yearbook 1937. Actual prices paid for specified sizes in 1938 as reported to the Bureau of Mines by producers are shown in the following table.

Average value per pound of domestic uncut sheet mica sold in 1938

Size	Clear	Stained or spotted	Size	Clear	Stained or spotted
Punch or washer	$0.056	$0.055	3 by 4 inches	$1.329	$0.870
Circle	.103	.151	3 by 5 inches	1.752	1.099
1½ by 2 inches	.262	.199	4 by 6 inches	2.758	1.353
2 by 2 inches	.510	.243	6 by 8 inches	4.127	1.495
2 by 3 inches	.871	.451	8 by 10 inches	8.394	1.297
3 by 3 inches	1.103	.630	10 by 12 inches	9.429	

FOREIGN TRADE [1]

Imports.—In 1938 the imports of mica aggregated only 5,761 short tons, compared with 11,339 tons in 1937. Moreover, whereas the quantity imported was roughly one-half the total for the preceding year, the declared value in 1938 was less than one-third. Imports of scrap mica were not listed separately before June 18, 1930, but it is generally conceded that they were unimportant until the late 1920's. They increased to 3,893 short tons in 1936 and to 6,723 tons in 1937. In 1938 they dropped to 4,450 tons; but as the imports of mica other than scrap dropped far more, the proportion of scrap to total imports was greater in that year than ever before. The chief value of the imports is in splittings, imports of which were reduced sharply because of the great curtailment in consumption and the large stocks already on hand. For many years the trend has been to use larger proportions of the lower-priced kinds of mica, and in 1938 the shrinkage in imports affected most of the higher-priced grades. Less unmanufactured sheet or block mica was imported in 1938 than in any year since 1932.

[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.

Mica imported for consumption in the United States in 1938, by kinds and by countries

Country	Unmanufactured									
	Waste and scrap, valued at not more than 5 cents per pound (duty, 25 percent)		Untrimmed Phlogopite mica from which no rectangular piece exceeding in size 1 inch, by 2 inches may be cut (duty, 15 percent)		Other				Total unmanufactured	
					Valued at not above 15 cents per pound (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	------	------	------	------	881	$104	1,921	$2,025	2,802	$2,129
Union of South Africa	1,473,550	$6,282	------	------	------	------	------	------	1,473,550	6,282
Argentina	------	------	------	------	11,948	1,527	13,685	6,079	25,633	7,606
Brazil	2,200	15	------	------	74,707	9,207	76,666	28,714	153,573	37,936
Canada	1,084,360	4,962	100	$12	15,966	1,386	4,095	2,253	1,104,521	8,613
France	------	------	------	------	------	------	1,924	2,688	1,924	2,688
India, British	6,340,848	17,331	------	------	6,681	852	175,930	54,853	6,523,459	73,036
United Kingdom	------	------	------	------	523	71	6,098	3,632	6,621	3,703
Total: 1938	8,900,958	28,590	100	12	110,706	13,147	280,319	100,244	9,292,083	141,993
1937	13,446,411	36,355	89,230	9,091	323,742	38,189	591,978	248,955	14,451,361	332,590

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	239,483	$47,740	------	------	------	------	239,483	$47,740
Brazil	65	24	1,570	$715	------	------	1,635	739
Canada	13,304	5,730	927	266	------	------	14,231	5,996
France	588	238	------	------	------	------	588	238
India, British	1,571,926	318,546	143,500	66,616	7,360	$5,074	1,722,786	390,236
United Kingdom	154	34	185	231	100	109	439	374
Total: 1938	1,825,520	372,312	146,182	67,828	7,460	5,183	1,979,162	445,323
1937	7,551,999	1,443,083	371,353	140,695	9,515	15,191	7,932,867	1,598,969

Country	Manufactured (cut or stamped to dimensions, shape, or form)							
	Cut (duty, 40 percent)		Disks (duty, 40 percent)		Other (duty, 40 percent)		Total cut or stamped	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Brazil	165	$318	------	------	------	------	165	$318
Canada	304	188	------	------	3,064	$1,492	3,368	1,680
Germany	6,478	6,638	------	------	------	------	6,478	6,638
India, British	22,917	28,450	10,071	$5,273	355	808	33,343	34,531
United Kingdom	174	1,286	------	------	410	473	584	1,759
Total: 1938	30,038	36,880	10,071	5,273	3,829	2,773	43,938	44,926
1937	122,848	61,330	14,850	8,841	1,075	639	138,773	70,810

Mica imported for consumption in the United States in 1938, by kinds and by countries—Continued

Country	Manufactured (other)				Total manufactured	
	Mica plates and built-up mica (duty, 40 percent)		Ground or pulverized			
	Pounds	Value	Pounds	Value	Pounds	Value
Africa: Madagascar					239,483	$47,740
Brazil					1,800	1,057
Canada	18,965	$18,500			36,564	26,176
France					588	238
Germany			169,025	$2,626	175,503	9,264
India, British					1,756,129	424,767
United Kingdom	18,551	11,051			19,574	13,184
Total: 1938	37,516	29,551	169,025	2,626	2,229,641	522,426
1937	67,307	60,240	82,200	1,233	[1] 8,226,786	[1] 1,735,009

[1] Includes 5,639 pounds valued at $3,757 of "All manufactures of which mica is the component material of chief value," no imports of which are shown in 1938.

As usual, British India was the principal source of imported scrap mica as well as of splittings and the more costly kinds of unmanufactured mica. Madagascar has become the second leading source of splittings, while Canada has fallen to a poor third. In 1938 the Union of South Africa displaced Canada from second place, even as a supplier of scrap. South American countries are increasingly important sources of block mica.

Under the reciprocal trade agreement with Canada, effective January 1, 1939, the duty on imported phlogopite mica waste and scrap valued at not more than 5 cents per pound was reduced from 25 percent ad valorem to 15 percent, and the duty on punch-size phlogopite (untrimmed) was lowered from 15 percent to 10 percent. Imports from Canada are amber mica or phlogopite, whereas those from all but one other country are muscovite. Madagascar, the only other producer of phlogopite, has never shipped scrap mica. The Canadian agreement also cut the duty on ground mica from 20 to 15 percent ad valorem. In discussing this latter change the Tariff Commission notes that although small quantities of mica are ground in other countries (Great Britain, Germany, France, and Japan), their combined output totals only a few hundred tons annually and the United States is on an export basis. Duties on other kinds of mica remain the same as in the original tariff act of 1930.

Exports.—Separate statistics of exports of ground mica became available for the first time in 1937, when they amounted to 1,532 tons, probably a record. The 1938 exports of 1,394 tons (worth $103,651) compare favorably with estimated foreign sales during the 1925–29 period and undoubtedly are greater than those for most years. The decline from the 1937 peak was due mainly to decreased shipments to Canada; shipments to United Kingdom, the largest buyer, increased slightly. Exports of unmanufactured mica increased by 139 tons but are unimportant. The shipments of manufactures other than ground mica, totaling 50,445 pounds valued at $75,379 in 1938, compare with 98,026 pounds and a value of $104,792 in the preceding year. This classification comprises principally repairs and replacements for American-made machinery and electrical apparatus.

Mica and manufactures of mica exported from the United States in 1938, by countries

Country	Unmanufactured		Ground or pulverized		Other	
	Pounds	Value	Pounds	Value	Pounds	Value
North America:						
Canada	420,639	$2,142	393,681	$15,089	30,683	$42,738
Cuba	-----	-----	449	26	737	1,196
Mexico	-----	-----	13,821	590	1,713	2,250
Other North America	500	10	-----	-----	881	2,163
South America:						
Argentina	-----	-----	11,185	561	1,769	1,388
Brazil	-----	-----	-----	-----	4,356	5,227
Chile	-----	-----	50	2	427	1,636
Venezuela	-----	-----	41,370	1,021	166	469
Other South America	-----	-----	-----	-----	956	1,112
Europe:						
Belgium	-----	-----	394,195	14,339	2,886	7,412
France	-----	-----	25,557	1,065	210	619
Germany	2,418	139	474,912	17,658	-----	-----
Netherlands	-----	-----	40,022	1,534	1,202	2,018
United Kingdom	202,240	1,768	1,290,589	47,863	192	614
Other Europe	-----	-----	77,752	2,689	1,880	2,849
Asia:						
China	-----	-----	400	27	50	100
India, British	80,000	800	-----	-----	500	1,034
Netherland India	-----	-----	11,600	521	210	186
Other Asia	-----	-----	-----	-----	319	629
Africa	-----	-----	3,605	145	303	927
Australia	-----	-----	8,600	521	1,005	812
Total: 1938	705,797	4,859	2,787,788	103,651	50,445	75,379
1937	427,381	3,895	3,064,869	108,171	98,026	104,792

WORLD PRODUCTION

World production of mica, 1934–38, by countries, in metric tons

[Compiled by M. T. Latus]

Country	1934	1935	1936	1937	1938
North America:					
Canada (sales)	905	570	726	857	342
United States (sold or used by producers)	7,267	[1] 17,527	[1] 19,609	[1] 23,626	[1] 18,803
South America:					
Argentina [2]	175	225	210	(3)	(3)
Bolivia [4]	4	2	-----	9	4
Brazil [4]	59	110	237	330	521
Peru	-----	-----	-----	5	22
Europe:					
Italy	5	34	12	24	(3)
Norway [4]	170	56	43	42	(3)
Rumania	-----	20	67	26	(3)
Sweden	16	32	125	68	(3)
U. S. S. R.	(5)	(5)	(3)	(3)	(3)
Asia:					
Ceylon [4]	(6)	2	(6)	1	(6)
Chosen	103	87	70	[7] 70	(3)
India, British [8]	4,720	7,204	9,026	15,106	13,633
U. S. S. R.	[5] 4,433	[5] 8,274	(3)	(3)	(3)
Africa:					
Eritrea	-----	-----	4	(3)	(3)
Madagascar [9]	294	522	410	583	(3)
Nigeria	-----	-----	-----	-----	3
Rhodesia:					
Northern	1	2	3	4	4
Southern	2	4	9	17	13
Tanganyika Territory	31	47	44	71	(3)
Union of South Africa (Transvaal)	630	582	495	1,740	1,161
Oceania:					
Australia:					
New South Wales	91	-----	-----	-----	(3)
Northern Territory (Central Australia)	49	44	21	42	(3)
South Australia	-----	-----	-----	43	(3)

[1] Includes following quantities recovered from kaolin and schists: 1935, 6,048 tons; 1936, 7,491 tons; 1937, 9,558 tons; 1938, 5,942 tons.

[2] Rail and river shipments. [3] Data not available. [4] Exports.

[5] Output of U. S. S. R. in Europe included under U. S. S. R. in Asia.

[6] Less than 1 ton. [7] Official estimate.

[8] Exports; the figures for output are incomplete, and a more accurate idea of the size of the industry can be obtained from the export figures (Rec. Geol. Survey of India, vol. 59, pt. 3, p. 273, Calcutta, 1926). Output in 1934, 2,830 tons; 1935, 2,985 tons; 1936, 4,423 tons; 1937, 5,308 tons.

[9] Exports reported as follows: 1934, 369 tons; 1935, 409 tons; 1936, 452 tons; 1937, 611 tons; 1938, 626 tons.

SUBVARIETIES OF MUSCOVITE

Volk,[2] after studying the optical and chemical properties of 22 samples of muscovite from all over the world, recommends three subdivisions: Potassium muscovite ($H_4K_2Al_6Si_6O_{24}$); phengite ($H_6K_2(Fe, Mg)_2Al_4Si_6O_{24}$); and ferric iron muscovite ($H_4K_2Fe_2'''Al_4Si_6O_{24}$). His formula for phengite differs from the old one, as it contains 1 more molecule of H_2O and FeO or MgO and 1 less of SiO_2. In all three subvarieties the ratio of R_2O (K_2O and Na_2O) to SiO_2 is 1 to 6. Ferric iron muscovite, when present in the system, increases the refractive index.

POSSIBLE SUBSTITUTES FOR MICA

The long quest for substitutes for mica in its principal electrical uses so far has been futile. No other substance combines many of mica's useful attributes. To escape dependence on large, unflawed sheets, which are rare in nature and hence costly, smaller sheets have been pasted or eyeletted together, and a fairly large industry has been established for making built-up mica from splittings. The built-up-mica industry, however, and the highly important fields that it serves have made the world more dependent than ever on British India for its mica. Not only has that country the largest mica mines, but it is one of the few countries where skilled labor is still cheap enough to permit splitting mica into thin films economically. Small books of mica that in the United States would be counted as waste fit only for grinding are converted laboriously into splittings in India. It is these splittings that are assembled and bonded—often with shellac, another Indian specialty—into built-up sheets or board, whether in the United States, England, Germany, France, or Japan.

Many years ago a large American company developed a substitute for built-up mica in commutator segments, and some of the electrical machinery in which it was used is still in satisfactory service. However, the material, which contained asbestos as an essential ingredient, tended to develop cracks after some time and so was abandoned. "Mycalex" is an important type of electrical insulation made by bonding coarsely ground mica with lead borate or soft glass; it competes with porcelain but not with sheet mica or mica board.

As noted in the introduction to this chapter, in 1938 there appeared a new material that promises to compete with sheet mica and perhaps displace mica board for a variety of electrical purposes. It may have an even better field of use to replace existing varieties of insulating tapes, including those made from high-grade pan-packed mica splittings. This material, called "Alsifilm," was developed in the laboratories of Dr. Ernst A. Hauser, Massachusetts Institute of Technology chemistry professor. It is processed from bentonite, and available information as to its properties and methods of production is summarized in the Minerals Yearbook 1939 chapter on Clays.

The other new development is the possible use of ground mica for certain applications of sheet mica or splittings. Japan is rumored to have made advances in this field, and an American inventor recently applied for patents and disclosed his plans to Bureau of Mines engineers.

[2] Volk, G. W., Optical and Chemical Studies of Muscovite: Am. Mineral., vol. 24, No. 4, April 1939, pp. 255-266.

SALT

By A. T. Coons and F. E. Harris

SUMMARY OUTLINE

After an all-time record of 9,241,564 short tons valued at $24,131,733 in 1937 the output of salt from domestic mines, wells, and ponds dropped 13 percent to 8,025,768 tons valued at $23,242,561 in 1938. According to reports of producers 2,429,100 tons of evaporated salt (valued at $15,566,439), 1,901,861 tons of rock salt (valued at $6,252,081), and 3,694,807 tons of salt in brine (valued at $1,424,041) were sold or used in 1938.

For a number of years salt in brine has comprised roughly one-half the salt production of the country. In 1937 it aggregated one-half of the total but in 1938 only 46 percent. The million-ton drop in total output of salt in 1938 was accounted for almost entirely by the 936,773-ton decrease in the production of salt in brine. The output of evaporated salt was only 150,452 tons less than in 1937, while that of rock salt dropped only 128,571 tons.

Salient statistics of the salt industry in the United States, 1930–34 (average) and 1935–38

	1930–34 (average)	1935	1936	1937	1938
Sold or used by producers:					
Manufactured (evaporated) short tons	2, 251, 226	2, 330, 042	2, 539, 597	2, 579, 552	2, 429, 100
In brine do	3, 333, 391	3, 837, 613	4, 279, 760	4, 631, 580	3, 694, 807
Rock salt do	1, 822, 889	1, 759, 242	2, 009, 579	2, 030, 432	1, 901, 861
Total:					
Short tons	7, 407, 506	7, 926, 897	8, 828, 936	9, 241, 564	8, 025, 768
Value [1]	$22, 331, 641	$21, 837, 911	$23, 306, 177	$24, 131, 733	$23, 242, 561
Average per ton [1]	$3. 01	$2. 75	$2. 64	$2. 61	$2. 90
Imports for consumption:					
For curing fish short tons	20, 360	26, 990	21, 711	21, 079	21, 010
Value	$34, 492	$53, 623	$44, 382	$45, 106	$47, 800
In bags, barrels, etc short tons	2, 620	1, 960	1, 388	802	654
Value	$24, 796	$15, 590	$12, 263	$8, 008	$8, 228
In bulk short tons	16, 721	22, 295	27, 942	24, 115	17, 849
Value	$37, 579	$38, 558	$56, 137	$80, 248	$45, 897
Total:					
Short tons	39, 701	51, 245	51, 041	45, 996	39, 513
Value	$96, 867	$107, 771	$112, 782	$133, 362.	$101, 925
Exports:					
Short tons	88, 662	112, 213	76, 974	70, 111	67, 498
Value	$642, 384	$549, 522	$463, 670	$514, 858	$469, 708
Apparent consumption short tons	7, 358, 545	7, 865, 929	8, 803, 003	9, 217, 449	7, 997, 783

[1] Values are f. o. b. mine or refinery and do not include cost of cooperage or containers.

The chemical industries as a group were not affected as much as other industries by the 1932 depression, and they recovered faster. Heavy chemicals made from brine fared even better than other chemicals. Soda ash, for example, was aided by the growth in the glass industry, now the leading consumer of this material, and caustic soda shared in expansion of the rayon industry. The average monthly index of rayon deliveries rose from 74 in 1923 to 296 in 1929 and subsequently rose even more spectacularly to 816 in 1938. Meanwhile the Federal Reserve Board index for general business increased only from 102 in 1923 to 118 in 1929 and dropped to only 86 in 1938. Paper manufacture, another large consumer of soda ash and caustic soda, likewise has been much more active than other industries. For these reasons the output of salt in brine is still relatively high, even after the million-ton drop in 1938. In terms of index numbers based on percentages of the 1923–25 average output, it stood 50.5 points higher than the index of general industrial activity. The index for evaporated and rock salt, which depend on the relatively stable food industries, was 10 points higher than the general index. (See fig. 1.)

A report [1] on the marketing of salt was published early in 1939.

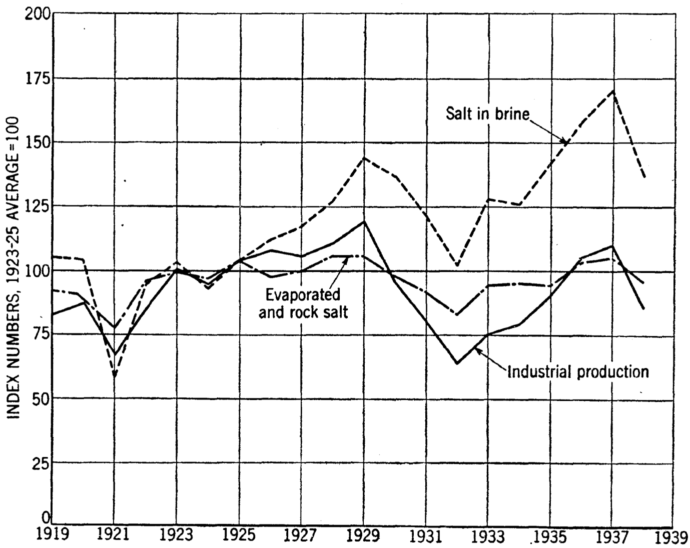

FIGURE 1.—Index of salt used in brine and evaporated and rock salt compared with Federal Reserve Board index of industrial activity, 1919–38.

PRODUCTION

Notwithstanding a decrease in output, 79 plants (63 companies) reported operations in 1938 compared with 73 plants (59 companies) in 1937. 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 Minerals Yearbook. Those in 1938 are as follows: Oliver Bros. Salt Co. and the American Salt Co. reopened and operated solar salt works at Mt. Eden, Alameda County, Calif.; the United States Vanadium Corporation, Uravan, Colo., produced evaporated salt for use in its own works at Bedrock,

[1] Harris, F. E., Marketing of Salt: Bureau of Mines, Inf. Circ. 7062, 1939, 56 pp.

Montrose County, Colo.; the Arenac Salt Co. was reported to have started operations near Sterling, Saginaw County, Mich.; plants along the Virgin River in Clark County, Nev., formerly producing small quantities of salt, have been submerged by the Boulder Dam project; the Union Potash & Chemical Co., Carlsbad, Eddy County, N. Mex., produced a small quantity of rock salt in connection with its development of potash deposits; Ezra S. Blackman, Freedom, Wood County, Okla., gathered a small quantity of solar salt from salt streams—a small refinery owned by him at this place was idle in 1938; the Crane Salt Co., Crane City, Crane County, Tex., started to produce solar salt from a salt lake on a small scale in 1938; and the Crystal White Salt Co., Salt Lake City, Utah, began construction of a plant at Grantsville, Tooele County, but no salt was marketed.

On the accompanying map (fig. 2) showing salt works and commercial deposits, prepared in collaboration with H. I. Smith, Geological Survey, no attempt has been made to include idle or abandoned plants. Only those plants producing in 1938 are shown. Because of the small scale of the map, surface deposits from which the salt is merely gathered, crushed, and sold without further treatment have been given the same designations as rock-salt mines and works where the salt occurs at depth. There are several such operations in California and near Redmond, Utah.

Several recent discoveries are shown on the map. A report [2] of the Louisiana Geological Survey refers to the 68 known salt domes of that State and cites the discovery (in 1937) of salt at Rodessa in northern Louisiana as an indication that a connection may exist between the North Louisiana and East Texas salt-dome areas. The North and South Louisiana salt-dome regions also may be connected, but the 60-mile-wide strip separating them is as yet relatively unexplored and is not mapped as salt bearing. New deposits have been discovered incident to drilling for oil in counties bordering the lower Gulf Coast region of Texas. In the Paradox Valley of Utah and western Colorado thick deposits of salt have been found, indicating an extensive salt field.

The following tables contain 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 certain 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, 1936–38, by States

State	1936		1937		1938	
	Short tons	Value	Short tons	Value	Short tons	Value
California	368,290	$2,576,873	370,911	$1,817,830	349,856	$1,940,449
Kansas	704,164	2,580,166	654,089	2,759,062	597,909	2,565,447
Louisiana	918,414	2,436,971	974,403	2,898,826	958,186	2,775,384
Michigan	2,354,282	5,882,718	2,476,406	6,506,120	2,078,612	6,151,154
New York	2,021,983	5,609,932	2,084,867	5,795,551	1,717,064	5,467,077
Ohio	1,633,056	2,545,027	1,733,875	2,625,644	1,489,270	2,562,620
Puerto Rico	10,951	43,705	12,116	53,381	12,508	61,917
Texas	316,006	615,815	364,780	623,037	324,449	624,096
Utah	56,480	168,706	69,696	205,328	61,959	192,495
West Virginia	117,401	719,382	128,715	713,421	129,568	721,490
Other States [1]	327,909	126,882	371,706	133,533	306,387	180,432
	8,828,936	23,306,177	9,241,564	24,131,733	8,025,768	23,242,561

[1] 1936–37: New Mexico, Oklahoma, and Virginia; 1938: Colorado, New Mexico, Oklahoma, and Virginia.

[2] Louisiana Geological Survey, Department of Conservation, Origin of the Cap Rock of Louisiana Salt Domes: Geol. Bull. 11, August 1938, p. 19.

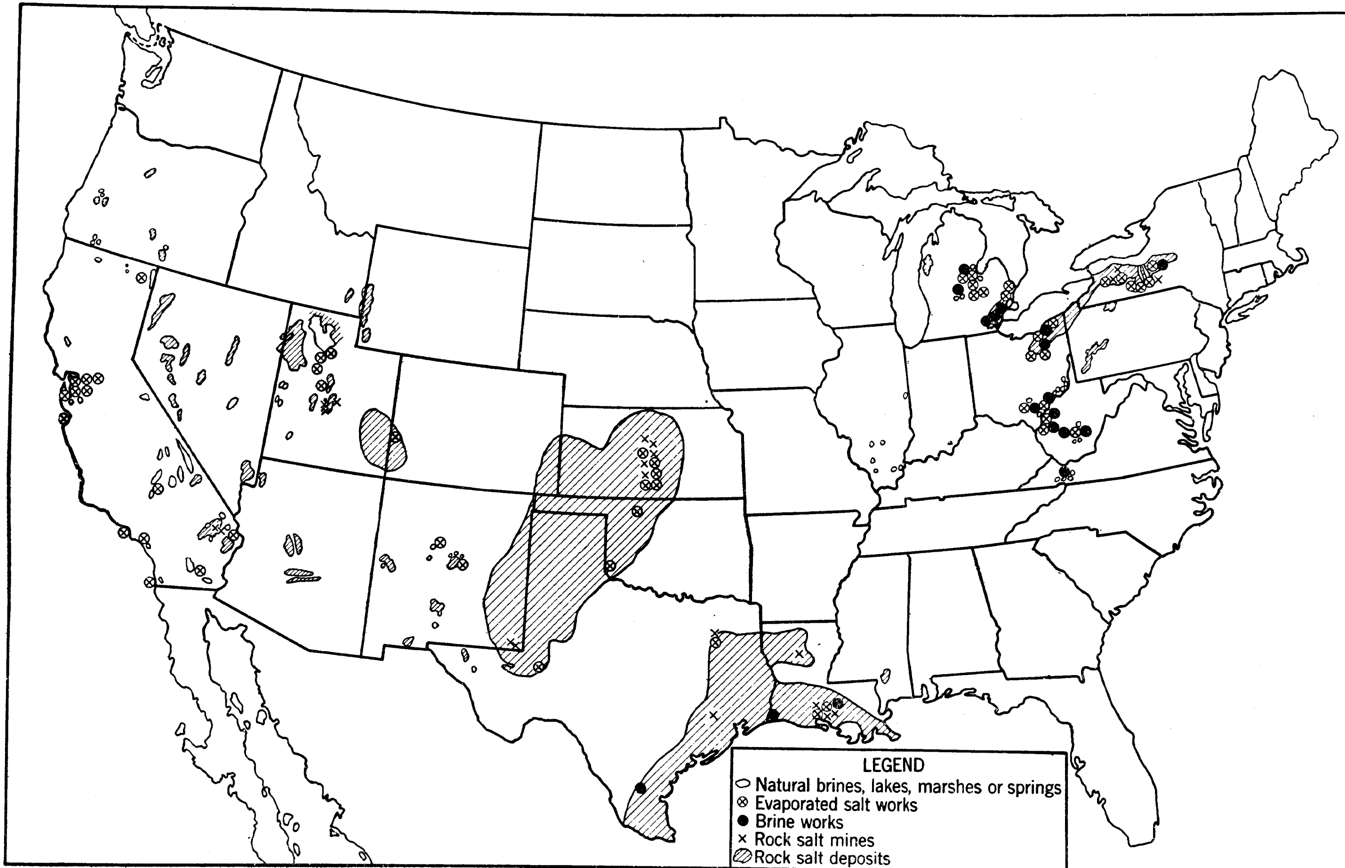

FIGURE 2.—Geographical distribution of salt-producing plants in the United States in 1938 and principal known deposits.

Salt sold or used by producers in the United States, 1937–38, by methods of manufacture

Method of manufacture	1937		1938	
	Short tons	Value	Short tons	Value
Evaporated in open pans or grainers	493, 039	$4, 088, 048	482, 154	$4, 025, 375
Evaporated in vacuum pans	1, 603, 825	9, 424, 260	1, 479, 806	9, 072, 224
Solar evaporated	362, 627	1, 342, 153	330, 441	1, 352, 568
Pressed blocks from evaporated salt	120, 061	966, 812	136, 699	1, 116, 272
Rock	2, 001, 451	6, 207, 397	1, 865, 603	5, 970, 972
Pressed blocks from rock salt	28, 981	240, 251	36, 258	281, 109
Salt in brine (sold or used as such)	4, 631, 580	1, 862, 812	3, 694, 807	1, 424, 041
	9, 241, 564	24, 131, 733	8, 025, 768	23, 242, 561

Evaporated salt.—The output of evaporated salt, produced by 37 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, amounted to 2,429,100 tons valued at $15,566,439 in 1938. This includes 136,699 tons of cattle-salt blocks valued at $1,116,272 produced by 17 plants. Of the evaporated-salt plants, 22 used solar methods. Most of the salt comes from sea water in San Francisco Bay, Calif., and some from salt lakes and playas in Utah, New Mexico, Oklahoma, and Texas. Although a large quantity of solar salt is sold crude, that sold as table salt and for some industrial uses commonly is refined.

Evaporated salt sold or used by producers in the United States, 1937–38, by States

State	1937		1938	
	Short tons	Value	Short tons	Value
California	362, 917	$1, 785, 854	343, 008	$1, 912, 637
Kansas	238, 179	1, 869, 150	217, 918	1, 724, 635
Michigan [1]	896, 946	4, 735, 464	841, 836	4, 672, 529
New York	372, 635	3, 562, 823	340, 137	3, 378, 167
Ohio	395, 665	2, 323, 195	372, 711	2, 307, 949
Puerto Rico	12, 116	53, 381	12, 508	61, 917
Texas	38, 443	202, 482	38, 362	208, 533
Utah	65, 902	191, 521	56, 597	173, 746
West Virginia [1]	128, 715	713, 421	129, 568	721, 490
Other States [2]	68, 034	374, 982	76, 455	404, 836
	2, 579, 552	15, 812, 273	2, 429, 100	15, 566, 439

[1] Includes a quantity of salt content of brine for chemical use reported as evaporated salt with value as evaporated salt.
[2] 1937: Louisiana, New Mexico, and Oklahoma; 1938: Colorado, Louisiana, New Mexico, and Oklahoma.

Rock salt.—Production of rock salt reported by 21 plants aggregated 1,901,861 tons valued at $6,252,081. The total includes 36,258 tons of blocks valued at $281,109, produced by eight plants. New York again led in rock-salt production, followed by Louisiana, Kansas, and Michigan. These four States produced 92 percent of the total rock salt mined. Texas now produces considerable rock salt, and California, New Mexico, and Utah also are producers.

Rock salt sold by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	1,913,182	$6,306,095	1937	2,030,432	$6,447,648
1935	1,759,242	5,510,413	1938	1,901,861	6,252,081
1936	2,009,579	6,003,054			

Salt content of brine.—The quantity of salt in brine sold or used by producers for the manufacture of chemicals in 1938 was 3,694,807 short tons, a 20-percent decrease from the 4,631,580 tons in 1937 but still 11 percent greater than the 1930–34 average, and 13 percent greater than the 1925–29 average. Salt in brine was produced at 10 plants in 1938, excluding 2 plants where the product is reported as evaporated salt rather than as salt in brine. The greater part of this salt is used by the producers in the manufacture of their own chemical products, but some is now being sold in the form of brine to other manufacturers.

Pressed blocks.—The output of pressed blocks from both evaporated and rock salt, reported by salt producers, was 172,957 tons valued at $1,397,381. Blocks from evaporated salt, which comprised 79 percent of all reported, were made chiefly in Kansas and Michigan, but smaller quantities were produced in California, Texas, Ohio, Utah, Louisiana, and New York. Blocks from rock salt were made chiefly in Louisiana and Kansas, with small quantities in Texas and Utah. The figures herein reported do not include pressed blocks made from salt bought in the open market. The higher unit value of blocks is due largely to the labor involved in shaping and sizing the blocks and to the inclusion of other materials beneficial to cattle.

Pressed-salt blocks sold by original producers of the salt in the United States, 1934–38

Year	From evaporated salt		From rock salt		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1934	139,445	$999,170	29,344	$166,269	168,789	$1,165,439
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

DISTRIBUTION

The following table was compiled from data furnished by the producers only, no account having been taken of reshipments. Information was supplied by all but two producers, and the necessary inclusion of their sales with shipments to "Other" States makes the figures for some States incomplete.

Distribution (shipments) of evaporated and rock salt in continental United States, 1937–38, by States of destination, in short tons

Destination	1937 Evaporated	1937 Rock	1938 Evaporated	1938 Rock
Alabama	6,464	29,726	6,194	31,532
Arizona	6,827	2,774	7,387	2,444
Arkansas	7,104	21,051	6,451	19,103
California	220,282	7,794	218,599	6,848
Colorado	22,367	13,908	23,910	11,330
Connecticut	12,794	4,217	13,234	4,198
Delaware	3,471	42,523	2,446	34,330
District of Columbia	4,909	1,050	4,742	1,053
Florida	5,911	19,073	5,681	18,271
Georgia	14,967	41,001	14,779	40,325
Idaho	12,134	728	10,411	2,966
Illinois	237,087	136,441	220,080	127,751
Indiana	60,730	53,609	60,197	36,608
Iowa	62,186	73,076	68,435	75,020
Kansas	40,948	137,605	37,542	120,527
Kentucky	29,549	16,151	32,841	13,153
Louisiana	5,366	46,185	5,909	51,564
Maine	9,646	20,968	6,855	16,978
Maryland	29,236	23,444	24,744	20,424
Massachusetts	50,635	27,997	47,667	30,206
Michigan	263,064	40,769	222,588	42,652
Minnesota	76,500	63,755	80,438	60,266
Mississippi	2,743	27,129	2,645	29,966
Missouri	56,695	55,698	56,717	48,943
Montana	13,656	2,095	13,378	1,914
Nebraska	27,817	42,937	24,263	40,378
Nevada	2,418	168	2,054	115
New Hampshire	5,492	29,269	3,552	26,065
New Jersey	63,077	106,794	55,075	101,173
New Mexico	4,897	12,182	4,513	10,741
New York	192,658	341,519	182,528	318,836
North Carolina	41,231	34,254	35,842	30,185
North Dakota	10,979	4,483	10,064	4,550
Ohio	133,180	65,767	126,483	50,989
Oklahoma	24,400	27,455	22,783	27,481
Oregon	22,104	387	21,633	331
Pennsylvania	107,504	86,142	105,493	72,205
Rhode Island	11,394	6,586	7,544	6,272
South Carolina	7,270	12,948	6,982	15,165
South Dakota	12,456	11,628	11,870	13,426
Tennessee	22,712	38,071	23,767	36,812
Texas	43,909	147,824	43,008	135,054
Utah	14,281	2,133	12,500	3,443
Vermont	5,662	4,286	4,673	4,915
Virginia	46,290	27,843	46,718	28,829
Washington	89,869	997	84,692	500
West Virginia	134,689	51,460	135,754	67,244
Wisconsin	105,143	22,863	95,801	21,619
Wyoming	7,653	3,272	7,358	2,803
Other [1]	187,196	40,397	160,280	34,358
	2,579,552	2,030,432	2,429,100	1,901,861

[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, 1937–38, in short tons

Territory	1937 Short tons	1937 Value	1938 Short tons	1938 Value
Alaska	7,555	$108,789	6,130	$97,858
American Samoa	3	171	4	264
Guam	50	1,502	37	1,287
Hawaii	2,047	53,758	2,144	55,402
Midway Island	(1)	5	1	22
Puerto Rico	1,041	26,759	1,282	33,781
Virgin Islands	16	879	10	603
Wake Island	2	95	1	20
	10,714	191,958	9,609	189,237

[1] Less than 1 ton.

VALUE AND PRICES

The average unit value for all salt at the mine, as reported by producers, rose 29 cents per short ton—from $2.61 in 1937 to $2.90 in 1938. Manufactured (evaporated) salt averaged $6.41 and rock salt $3.29 in 1938, 28 and 11 cents higher than in 1937.

Quoted prices of salt delivered at New York rose at the beginning of 1938 to $13.20–$13.80 (from $11.80–$12.80 in 1937) per ton for carlots of bagged rock salt and to $15–$15.60 (from $14–$14.50) for less than carlots. Those for vacuum common fine salt rose to $15.30–$15.70 (from $14.80) for carlots and to $16.50–$17 (from $15.50) for less than carlots. At the end of May 1938, prices for salt at New York rose again and remained nominally unchanged the remainder of the year, as follows: $13.20–$13.80 per ton for bagged rock salt in carlots and $15–$15.60 per ton in less than carlots; $15.30 per ton for bagged vacuum fine salt in carlots and $16.30–$21 per ton in less than carlots.

PROGRESS IN TECHNOLOGY AND USES

The salt reported as salt in brine is consumed almost entirely in the manufacture of chemicals by the producers and does not enter the open market. Most of the other salt used in the manufacture of chemicals is evaporated salt which is marketed and sold by producers to chemical companies. As dry salt for chemical use is readily shipped, chemical companies using it need not be situated as close to the supply as those using brine for their raw material. Although most of the chemical companies that use brine are near the base of supply, one chemical company that owns its own brine-salt plant is more than 60 miles from the brine source. The brine is brought by gravity to the chemical plant through a 60-mile line of cast-iron pipes 14 inches in diameter, which is the longest pipe line of its kind in the world.

The utilization of the caustic soda produced with chlorine from salt is becoming increasingly important to chemical manufacturers. One method devised recently, based on treating the salt with nitric acid obtained by oxidizing synthetic ammonia, yields chlorine and a fertilizer-grade nitrate of soda. The production of salt cake by treatment of rock salt with sulfuric acid also is receiving attention.

Bureau of Mines engineers recently were asked to help solve a problem in pipe-line transportation at a western oil well where the company had difficulty because of the line freezing in cold weather, and they recommended the addition of salt. The water, unlike that at most oil fields, was fresh, and when the company pumped a saturated solution of salt water (roughly 4 tons of salt to 165 barrels of water) into its 20-mile line relief came in about 8 hours.

An ingenious system [3] of drying salt is claimed to produce a saving in the cost of steam at the Diamond Crystal Salt Division of the General Foods Corporation, St. Clair, Mich. The application of flow controllers to the Alberger and the interconnected triple-effect evaporator plants is another interesting development. The excess steam from the Alberger plant is utilized for the triple vacuum-pan evaporators, and the system of control takes care of any excess or deficiency of steam to the evaporators.

[3] Diamond, H. W., and Berry, N. E., Paper presented before the Conference on Instrumentation in the Process Industries at Carnegie Institute of Technology, Pittsburgh, Pa., Mar. 2, 1939, noted in Chem. and Met. Eng., vol. 46, No. 3, March 1939, p. 142.

One of the most interesting developments in 1938 was the manufacture of large crystals from purified molten salt. Experiments in the laboratories of Harvard University and the Massachusetts Institute of Technology on the manufacture of large single crystals of salt in cylindrical bars 2 centimeters in diameter and 30 centimeters in length have proved the practicability of such material for optical use. In 1938 the Harshaw Chemical Co., Cleveland, Ohio, undertook the manufacture of these crystals. Sometimes the single crystals, which are remarkably clear when correctly developed, weigh as much as 25 pounds. Careful maintenance of the proper temperatures during their manufacture and annealing is most important.

In 1938 interest was shown in the problem of eliminating corrosion and pitting in equipment for salt making and that exposed to salt or brine in processing industries. The practical commercial application of noncorrosive metals and alloys in salt making was described and an installation that had withstood 4 years' wear was cited in a London journal.[4]

The impurities in salt are some of the worst attackers of equipment. In most modern salt works these impurities are removed chemically from the brine before it goes to the refining pans. However, it is advisable to use the most resistant metals or alloys and thereby reduce corrosion and scaling, which are particularly serious in the vacuum-pan process of evaporation because they interfere with the transfer of heat. The use of Monel-metal wire cloth and woven-wire filtering and conveying belts also is said to be gaining. The resistance to corrosion of Monel metal is attributed to its high nickel content.

"Pink" salt is imported into the United States (20 to 25 thousand tons annually) chiefly for curing fish along the Atlantic seaboard. This salt is predominantly sea salt that is subject to the pink bacteria. The data given in a recent report [5] are of practical value to purchasers of salt for curing fish. This report states further that the California solar salt "contains over 99 percent sodium chloride, a much higher percentage than usually obtains in products from the European salines."

FOREIGN TRADE [6]

The duty on salt was reduced under the trade agreements with the United Kingdom and Canada which were approved in November 1938 and became effective January 1, 1939. The duty on bulk salt was reduced 43 percent—from 7 cents per 100 pounds to 4 cents per 100 pounds, or a 24-percent ad valorem equivalent, under agreements with both countries. The duty on packaged salt was reduced 36 percent—from 11 cents per 100 pounds to 7 cents per 100 pounds, or a 14-percent ad valorem equivalent, under the agreement with Canada.

Total imports of dutiable salt, chiefly in bulk, are small compared with domestic production.

Imports of salt decreased 14 percent in quantity and 24 percent in value in 1938; most of the decrease was in bulk salt. Nearly one-half of the imports in 1938 were from Tunisia, which with Jamaica and Canada supplied 98 percent of the imported salt.

[4] Chemical Age, Monel Metal in the Salt Industry: Vol. 39, No. 1002, Sept. 10, 1938, p. 192. (Abstracted in Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 4, Oct. 20, 1938, p. 29.)

[5] Wilson, Anna M., Production and Composition of Commercial Salt: Dept. of Natural Resources of the Newfoundland Government, Service Bull. 7, 1938, 14 pp. (Abstracted in Bureau of Mines, Mineral Trade Notes: Vol. 7, No. 2, August 1938, p. 23.)

[6] 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 of salt decreased 4 percent in quantity and 9 percent in value in 1938 compared with 1937. Shipments to Japan, which decreased 75 percent in 1937, increased 21 percent in 1938; however, shipments to Canada, Mexico, Cuba, Australia, and New Zealand, the other large markets for salt, decreased.

Salt imported for consumption in the United States, 1937–38, by countries

Country	1937		1938	
	Short tons	Value	Short tons	Value
North America:				
Canada	5,986	$14,186	8,130	$18,724
West Indies:				
British:				
Jamaica	24,144	45,407	12,100	26,991
Other British	85	710	40	529
French	8	130		
Netherland	409	972	348	765
Europe:				
France			2	32
Germany	175	1,479	15	612
Sweden	(1)	50		
Switzerland			1	40
U. S. S. R.			(1)	803
United Kingdom	153	2,345	273	3,775
Asia: Philippine Islands	135	945		
Africa:				
Egypt	8,456	44,053		
Tunisia	6,445	23,085	18,604	49,654
	45,996	133,362	39,513	101,925

1 Less than 1 ton.

Salt exported from the United States, 1937–38, by countries

Country	1937		1938	
	Pounds	Value	Pounds	Value
North America:				
Bermuda	62,656	$724	56,575	$651
Canada	89,500,877	206,260	87,186,928	181,063
Central America:				
British Honduras	849,752	5,304	808,971	4,395
Guatemala	76,233	585	227,806	1,785
Honduras	280,946	3,180	300,077	3,957
Nicaragua	427,141	3,597	620,983	5,155
Panama 1	1,059,554	11,501	1,402,711	18,473
Mexico	7,587,564	54,086	6,743,753	48,193
Newfoundland and Labrador	673,478	1,435	884,098	1,584
West Indies:				
British	96,433	1,317	71,117	1,394
Cuba	21,808,885	111,871	18,341,667	97,260
Dominican Republic	458,540	8,736	476,445	7,791
Haiti	41,227	723	29,520	613
Netherland	112,541	2,338	237,320	3,952
Other North America	39,047	551	69,394	606
South America:				
Argentina	642,360	3,758	409,410	2,198
Brazil			140,780	599
Colombia	29,283	928	14,356	221
Other South America	48,566	403	26,511	309
Europe:				
Ireland	5,000	500	15,890	1,597
United Kingdom	172,590	5,384	24,145	544
Other Europe	16,035	432	12,783	321
Asia:				
China	18,036	1,039	10,209	618
Hong Kong	57,635	1,198	36,779	1,166
Japan	9,336,090	11,886	11,294,250	21,080
Philippine Islands	560,055	9,198	739,020	12,873
Other Asia	64,292	1,548	54,090	1,597
Africa	22,721	782	51,765	1,556
Oceania:				
British:				
Australia	3,517,789	34,574	2,457,689	22,173
New Zealand	2,282,502	26,641	1,852,600	21,664
French	374,538	4,379	397,455	4,320
	140,222,366	514,858	134,995,097	469,708

1 Includes exports to Canal Zone: 1,373,235 pounds, valued at $17,828, in 1938; not separately classified in 1937.

WORLD PRODUCTION

World production of salt, 1933–37, by countries, in metric tons

[Compiled by M. T. Latus]

Country [1]	1933	1934	1935	1936	1937
North America:					
Canada	262,546	293,960	324,975	355,486	416,360
Costa Rica	2,900	3,330	3,500	3,500	4,287
Guatemala	5,627	2,913	2,073	5,665	9,427
Mexico	90,730	(2)	57,746	(2)	101,628
Nicaragua	28	------	------	------	------
Panama	2,604	4,947	5,541	4,385	6,898
United States:					
Rock salt	1,619,309	1,735,600	1,595,949	1,823,050	1,841,967
Other salt	5,279,769	5,169,921	5,595,173	6,186,384	6,541,795
West Indies:					
British:					
Bahamas [3]	2,865	3,175	545	------	5,003
Leeward Islands [3]	35	1,357	------	------	------
Turks and Caicos Islands [3]	24,960	18,963	28,803	41,899	50,833
Cuba	35,000	20,964	36,921	34,339	36,287
Netherland [3]	9,401	6,479	3,781	2,285	2,337
South America:					
Argentina [4]	205,568	194,443	234,441	247,433	290,123
Brazil	153,045	280,978	349,521	494,120	707,465
Chile	44,649	31,210	36,453	47,232	36,697
Colombia	161,097	181,052	181,613	171,455	164,636
Ecuador:					
Rock salt	109	114	119	138	138
Other salt	35,428	28,902	32,039	16,632	13,800
Peru	33,622	34,343	35,397	36,110	39,010
Venezuela	(2)	28,357	(2)	30,361	[5] 25,000
Europe:					
Bulgaria:					
Rock salt	6,000	6,138	5,330	6,768	9,745
Other salt	14,000	48,722	36,629	47,000	43,602
Czechoslovakia	156,565	147,299	163,843	172,647	165,898
France:					
Rock salt and salt from springs	1,615,890	1,673,280	1,604,660	1,711,060	1,847,179
Other salt	513,250	398,070	356,650	202,040	480,906
Germany:					
Rock salt	1,841,276	2,024,194	2,077,316	2,383,832	2,757,242
Other salt	426,297	509,316	561,588	574,491	569,537
Austria:					
Rock salt	1,075	864	1,257	712	908
Other salt	140,669	163,732	198,209	191,294	169,883
Greece	73,448	107,696	113,980	74,447	102,285
Italy:					
Rock salt	344,091	393,306	483,436	499,798	603,798
Other salt	709,413	576,742	671,084	770,333	952,655
Malta	1,219	2,235	2,032	1,930	1,829
Netherlands: Rock salt	[6] 64,949	74,759	70,963	76,271	132,430
Poland	449,492	506,383	515,094	466,525	602,746
Portugal [3]	55,315	56,511	81,965	73,944	(2)
Rumania:					
Rock salt	281,131	308,723	308,921	283,389	321,805
Other salt	------	------	1,542	1,750	2,077
Spain:					
Rock salt	156,756	160,023	(2)	(2)	(2)
Other salt	772,460	602,308	(2)	(2)	(2)
Switzerland	80,348	81,596	79,757	81,177	91,969
U. S. S. R.	[7] 2,734,000	[7] 3,544,000	[7] 4,349,500	(2)	(2)
United Kingdom:					
Great Britain:					
Rock salt	19,835	17,650	16,571	17,569	18,666
Other salt	2,376,766	2,528,634	2,713,377	2,845,242	3,101,511
Ireland, Northern:					
Rock salt	2,107	3,533	3,282	3,175	4,254
Other salt	9,412	10,500	10,199	12,297	8,818
Yugoslavia	45,115	41,922	43,549	45,205	46,323
Asia:					
Aden	313,074	361,119	345,119	361,098	371,027
Burma	36,363	37,569	40,729	32,790	54,677
Ceylon	8,354	63,449	41,612	40,382	38,815
China [8]	3,170,000	3,220,000	[5] 3,000,000	[5] 3,000,000	[5] 3,000,000
Chosen [5]	138,000	138,000	138,000	138,000	138,000
Cyprus [5]	3,000	3,000	3,000	3,000	3,000

See footnotes at end of table.

World production of salt, 1933–37, by countries, in metric tons—Continued

Country	1933	1934	1935	1936	1937
Asia—Continued.					
India:					
British:					
Rock salt	1,390,443	1,596,531	1,593,593	1,369,861	1,516,984
Other salt	172,895	182,047	181,214	175,020	190,103
Portuguese	126,115	209,219	160,681	24,047	26,095
Indochina	114,814	160,536	203,210	192,237	193,558
Iraq [9]	3,739	5,333	2,394	2,804	1,810
Japan:					
Japan proper [10]	630,837	676,302	604,442	518,787	(2)
Taiwan	191,935	191,577	149,375	189,777	210,471
Netherland India	98,345	92,370	102,076	107,449	[11] 52,618
Palestine:					
Rock salt	878	859	867	755	727
Other salt	8,405	9,389	10,376	8,058	11,717
Philippine Islands	37,938	(2)	(2)	53,471	48,905
Siam [3]	84,742	126,565	138,504	44,505	132,898
Syria [5]	10,000	10,000	10,000	10,000	10,000
Turkey	152,400	190,602	214,688	220,500	222,226
U. S. S. R.	(7)	(7)	(7)	(7)	(7)
Africa:					
Algeria	77,878	42,885	67,990	62,400	63,767
Belgian Congo	892	888	894	920	1,004
Canary Islands [5]	2,000	2,000	2,000	2,000	2,000
Egypt [3]	136,426	288,470	257,104	237,570	276,735
Eritrea	92,497	96,000	2,380	62,000	10,000
Ethiopia: Rock salt	10,000	10,000	10,000	10,000	10,000
French West Africa	(2)	1,200	381	748	110
Kenya Colony	2,540	1,760	2,845	(2)	(2)
Libya (Italian Africa):					
Cyrenaica [5]	10,000	10,000	10,000	10,000	10,000
Tripolitania [5]	20,000	20,000	20,000	20,000	20,000
Mauritius [5]	1,500	1,500	1,500	1,500	1,500
Morocco, French	1,582	1,064	1,194	814	11,207
Nigeria [5]	400	400	400	400	400
Portuguese East Africa	(2)	1,689	3,436	2,520	(2)
Portuguese West Africa (Angola) [5]	25,000	25,000	25,000	25,000	25,000
Somaliland:					
British [3]	2,748	3,212	2,655	1,509	950
French [3]	34,297	35,497	76,500	21,985	85,273
Italian	216,317	(2)	(2)	(2)	(2)
South-West Africa: Rock salt	3,144	2,800	5,021	3,822	4,113
Sudan, Anglo-Egyptian	(2)	24,421	26,534	27,027	34,553
Tanganyika Territory	7,325	7,418	6,916	8,574	8,723
Tunisia	86,511	86,966	79,689	129,000	129,708
Uganda	1,516	4,950	1,590	3,405	3,133
Union of South Africa	88,174	83,233	87,261	97,904	106,338
Oceania:					
Australia:					
South Australia	59,527	62,063	79,255	67,391	74,739
Victoria [12]	41,055	46,813	48,356	(2)	(2)
Western Australia	(2)	2,713	(2)	4,295	3,729

[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] Estimated annual production.
[6] Sales.
[7] Output of U.S.S.R. in Asia included with U.S.S.R. in Europe.
[8] Includes Manchuria.
[9] Salt issued by the Government for sale.
[10] Year ended Mar. 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.
[11] Incomplete data.
[12] Year ended June 30 of year stated.

MAGNESIUM COMPOUNDS, BROMINE, CALCIUM CHLORIDE, IODINE, SODIUM SULFATE, BORATES, AND MISCELLANEOUS SALINES

By Paul M. Tyler and A. T. Coons [1]

SUMMARY OUTLINE

The world's largest mineral deposit is the ocean, which contains per cubic mile some 128,300,000 tons of sodium chloride (common salt), 18,000,000 tons of magnesium chloride, 7,800,000 tons of magnesium sulfate, 5,900,000 tons of calcium sulfate, 4,100,000 tons of potassium sulfate, 600,000 tons of calcium carbonate, and 360,000 tons of magnesium bromide, together with a host of minor constituents. A cubic mile of sea water weighs 4,710,000,000 tons. The ocean covers 70.73 percent of the earth's surface, or 132,295,000 square miles; its average depth is 2.38 miles and its total volume 331,522,100 cubic miles.[2] In 1937 the Ethyl-Dow Chemical Co. pumped through its North Carolina plant 111,984,000 tons of ocean water to extract some thousands of tons of bromine. The unrecovered minerals, if extracted, would have been worth $136,595,370 at current prices and weighed 4,090,147 tons, according to figures made public by an affiliated corporation.[3] The elements not recovered included 0.071 ton of gold, worth $59,700; 2.22 tons of silver, $34,600; 13 tons of copper, $6,770; 195 tons of aluminum, $81,900; 206 tons of iron, $16,460; and 4.54 tons of iodine, $10,440. The intake of common salt totaled 3,005,000 tons (valued at $45,100,000), Epsom salts 764,000 tons, calcium chloride 165,700 tons, potassium chloride 85,900 tons, and strontium carbonate 226 tons, in addition to 68,900 tons of magnesium in the form of chloride.

Salts are ionized in solution, and percentage estimates as to quantities of specified compounds can be altered, owing to the various rearrangements and new chemical combinations into which the elements can be made to enter. Most of the sodium compounds of

[1] Figures on imports compiled by M. B. Price, of the Bureau of Mines, from records of the Bureau of Foreign and Domestic Commerce.
[2] Taylor, H. F., A Cubic Mile of Ocean: Canadian Min. Jour., vol. 52, No. 29 December 1931, pp. 852–855.
[3] Universal Engineer, Unrecovered Chemicals: Vol. 68, No. 3, September 1938.

commerce, in fact, are recovered by processing common salt, and these manufactured compounds compete with those recovered more or less directly from sea water and natural brines.

Virtually all natural waters carry dissolved salts, and the flowage from wells or springs frequently is highly mineralized. Occasionally water is pumped down into beds of soluble salts and then brought back to the surface in the form of quasi-artificial brines. All these more or less natural brines are used as sources not only of common salt but also of other saline minerals. Great closed basins where rainfall is deficient and streams have no outlet to the ocean contain salt lakes or, more often, playas and marshy beds of dried-up lakes ranging in size from small sloughs with a scanty encrustation of salts on the surface of the mud to thick beds several miles in extent. Unique in the variety of minerals is the large deposit in Searles Lake, San Bernardino County, Calif., which, after several false starts, was first utilized in 1917 as a source of potash and subsequently has yielded as joint products borax, trona, sodium sulfate, and in 1938, lithium compounds as well. Somewhat similar operations are conducted at Owens Lake in Inyo County, Calif., which, however, yields chiefly soda ash, sodium bicarbonate, and trona. Both lakes yield borax but sodium borate produced in the form of kernite from near Mojave, Calif., and small quantities of colemanite (calcium borate) are also produced in California.

Magnesite formerly was virtually the only magnesium compound of large industrial importance, but later large quantities of dolomite were used not only for making basic carbonate for heat-insulating coverings but also for other compounds and for refractories. Then magnesium salts, separated from Michigan brines, became important, and in 1937 even dead-burned magnesite began to be synthesized in California from sea-water bitterns. Brucite, the natural hydrate of magnesia, was first mined in Nevada in 1934. The interchangeability of magnesium raw materials is illustrated further by the utilization in Europe of carnallite and kieserite, which occur in the German (Stassfurt) potash deposits. As yet the separation of magnesia from talc and other silicate combinations does not appear to be economical, but olivine (discussed in the Minor Nonmetals chapter of Minerals Yearbook) is mixed with magnesite and utilized for refractories of the "Forsterite" type.

Most important of all saline minerals is common salt, which is discussed in a separate chapter of Minerals Yearbook 1939. Potash likewise is treated in a separate chapter. Salt-works byproducts, however, including not only magnesium compounds but also calcium chloride, bromine, and iodine, are no longer included in the chapter with salt but are discussed in this chapter with magnesite and magnesium compounds, which in former years were treated separately in the Yearbook.

MAGNESITE

Following the usual pattern of refractory-product sales (which are more sensitive than consuming industries to an oncoming recession and do not pick up again until well along in the ensuing recovery), the apparent consumption of dead-burned magnesite in the United States in 1938 was 54 percent less than it was in 1937, whereas open-hearth steel production dropped only 44 percent. Total sales of domestic and imported caustic calcined magnesite dropped 31 percent and those of crude magnesite, never important, 52 percent.

The Northwest Magnesite Co. (executive offices, Farmers Bank Building, Pittsburgh, Pa.) operated two or three of its six kilns (300 tons total daily capacity) at Chewelah, Wash., for 8 months of the year. Crude magnesite was mined at both the Finch and Allen-Moss properties. Some of the deposits in this area measure hundreds of feet in width and merge indefinitely into the adjoining rock mass, so that their boundaries can be determined only by sampling and chemical analysis. The magnesite is interfingered with dolomite and contains disseminated calcite, talc, serpentine, quartz, and shale. Hitherto only the best parts of the deposit have been mined and great quantities of magnesite-bearing waste have been rejected. The Bureau of Mines and the State Electrometallurgical Research Laboratories, Pullman, Wash., in cooperation have worked out processes for beneficiating this material successfully by froth flotation. Electrothermal methods resembling those employed at Radenthein, Austria, are also being perfected for manufacturing magnesium metal, using power from Grand Coulee Dam.

Salient statistics of the magnesite industry in the United States, 1935–38

	1935	1936	1937	1938
Crude:				
Mined:				
Short tons	177,154	207,119	203,437	[1] 97,000
Value [1]	$1,192,052	$1,411,664	$1,483,492	[1] $725,000
Sold by producers:				
Short tons	1,626	1,669	1,952	919
Value	$22,345	$24,420	$29,203	$12,332
Average per ton [2]	$13.74	$14.63	$14.96	$13.42
Imports for consumption:				
Short tons	49	59	34	36
Value	$1,084	$1,130	$313	$777
Apparent new supply ... short tons	1,675	1,728	1,986	955
Percent domestic	97.1	96.6	98.2	96.2
Caustic calcined:				
Sold by producers:				
Short tons	6,049	7,998	10,031	7,400
Value	$170,326	$221,410	$311,326	$228,498
Average per ton [2]	$28.16	$27.68	$31.04	$30.88
Imports for consumption:				
Short tons	1,441	2,196	2,798	1,452
Value	$36,076	$49,674	$62,420	$39,551
Apparent new supply ... short tons	7,490	10,194	12,829	8,852
Percent domestic	80.8	78.5	78.2	83.6
Dead-burned:				
Sold by producers:				
Short tons	72,438	89,979	83,204	38,738
Value	$1,361,949	$1,713,527	$1,598,336	$730,978
Average per ton [2]	$18.80	$19.04	$19.21	$18.87
Imports for consumption:				
Short tons	24,674	42,608	56,020	24,990
Value	$429,830	$662,567	$795,047	$371,669
Apparent new supply ... short tons	97,112	132,587	139,224	63,728
Percent domestic	74.6	67.9	59.8	60.8

[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.

The new sea-water plant of the Westvaco Chlorine Products Corporation (executive offices, 405 Lexington Avenue, New York, N. Y.) at Newark, Calif., was operated successfully in 1938, its product being sold throughout the year to the same customers who formerly purchased material from the company mines. The product is so nearly identical to the mine product from the standpoint of performance that certain users may not even have realized the source of the material they received. The Tycrete Chemical Corporation (Chula Vista, Calif.) reported production of crude magnesite in Imperial County, which it converted in a small rotary kiln into caustic-calcined magnesite for building uses.

A small quantity of magnesite was produced by the Eastern Magnesia Talc Co., Inc. (206 Bank Street, Burlington, Vt.) as a byproduct of its talc-milling operations at Johnson, Vt. The material is quite high in iron oxide, and a substantial tonnage should be available in 1939.

IMPORTS

The United States, usually a large buyer of Austrian dead-burned magnesite, reduced its imports of that material to 6,691 tons in 1938 from 24,271 tons in 1937, or 72 percent. Imports from Czechoslovakia declined 64 percent, whereas those from Manchuria (Kwantung) were less drastically curtailed. Of special interest was the relatively large importation from Japan, hitherto an insignificant source. It is believed that the 907 tons imported from Japan in 1938 came from newly exploited deposits in Chosen. Korean magnesite previously had been offered at around $10 a ton f. o. b. shipping point, and it was reported that Japanese vessels had agreed to transport it to any United States Atlantic port for $3 a metric ton, making the landed cost far below that of European magnesite.

With the announcement in August 1938 that the United States intended to negotiate a trade agreement with Venezuela, notice was given of possible reduction in the tariff protection on domestic magnesite that has been operative since 1922.

Magnesite imported for consumption in the United States in 1938, 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
Austria [1]							3,362	$49,000
Canada							6	563
China							84	1,003
Czechoslovakia							3,236	53,330
Germany [1]			(2)	$171	1	$56	3,329	54,860
Greece					94	2,765		
India, British	9	$70	359	6,164				
Japan							907	15,143
Kwantung							13,249	179,135
Netherlands	27	707			611	18,641		
U. S. S. R.							817	18,635
United Kingdom					19	1,097		
Yugoslavia			258	7,557	110	3,100		
	36	777	617	13,892	835	25,659	24,990	371,669

[1] Austria included with Germany beginning May 6.
[2] Less than 1 ton.

PRICES

At the beginning of the year the Engineering and Mining Journal was quoting dead-burned magnesite at $25 a short ton f. o. b. California or Washington (State) shipping points. 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 per ton. By May the quotation on dead-burned magnesite was reduced to $22 a ton, but in September the price of the California product was restored to $25. Quotations on other products remained unchanged throughout the year.

The average values realized on domestic sales, as calculated from returns from the producers to the Bureau of Mines, held up fairly well, although the slight gains made during the preceding 2 years were canceled. The figures for crude, caustic calcined, and dead-burned magnesite, respectively, were $13.42, $30.88, and $18.87 per ton in 1938 compared with $14.96, $31.04, and $19.21 in 1937.

THE INDUSTRY IN FOREIGN COUNTRIES

World production of magnesite, 1933–37, by countries, in metric tons [1]

[Compiled by M. T. Latus]

Country	1933	1934	1935	1936	1937
Anglo-Egyptian Sudan			256	(2)	
Australia:					
New South Wales	9,512	15,902	15,940	17,459	19,807
Queensland	152	42	102	102	(2)
South Australia	205	208	51	118	71
Victoria	6	26	335	219	143
Canada [3]	27,158	27,385	27,112	(4)	(4)
China (Manchuria)	71,376	72,000	157,000	206,000	(2)
Chosen	(2)	3,168	2,410	14,258	37,000
Czechoslovakia [5]	49,929	58,235	70,838	83,270	92,143
Germany:					
Austria	164,331	258,382	300,312	397,776	459,233
Prussia	(2)	11,010	13,818	15,026	21,091
Greece	44,719	70,388	93,563	116,106	161,676
India, British	15,450	15,215	17,257	15,716	26,586
Italy	2,187	1,100	1,251	3,155	5,392
Norway	2,007	2,500	2,526	3,116	2,096
Turkey	951	628	1,092	2,247	1,365
Union of South Africa	1,495	1,667	1,485	1,694	1,752
U. S. S. R.	380,300	482,000	(2)	(2)	(2)
United States	98,145	91,601	160,711	187,894	184,554
Yugoslavia [6]	14,602	25,086	30,225	39,008	41,967

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.
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 Serbia only.

Austria (Germany).—The "Anschluss" with Austria makes Germany a potentially important exporter of magnesite instead of a large importer. Following this coup d'état the name of the Austro-American Magnesite Co. of Radenthein was changed to Austrian Magnesite Co. (Österreichische Magnesit A. G.), but the majority stock interest is reported to be still held in the United States. About 50 percent of the Austrian exports of magnesite in 1937 were supplied by the Veitscher Magnesitwerke. A third company, the Styrian Magnesite Industry Co., Ltd., produces mostly caustic-calcined magnesite and has not been a member of the cartel comprising the other Austrian and Czechoslovak producers.

Deliveries of Austrian magnesite to Germany doubtless were higher in 1938 than in 1937 because production was probably greater and exports to other countries decreased. Exports of caustic calcined magnesite in 1938 were only 3,950 metric tons and of dead-burned 42,150 tons. Virtually no raw magnesite went outside the country in 1938, but 38,497 tons of magnesite brick and plates were exported, chiefly to France, England, and Italy. The United States is normally the largest buyer of Austrian dead-burned magnesite, but in 1938 exports to the United States were only 13,900 tons compared with 23,430 tons in 1937, and those to England declined moderately to 12,400 tons compared with 13,990 tons in 1937.

Canada.—Magnesitic dolomite, an intimate mixture of magnesite and dolomite, occurs at Kilmar and Harrington East, Argenteuil County, Quebec. In 1937 operations that previously were wholly open-cut were extended underground, and a modern new tunnel kiln was installed at the property of the Canadian Refractories, Ltd. This kiln, the fourth of its kind in the world, is 88 feet long and attains a temperature of 3,100° F. According to a statement by the Canadian Department of Mines and Resources, the products marketed at present include caustic calcined (for making flooring compositions and tile), dead-burned or grain material, bricks and shapes (burned and unburned), and refractory cements (finely ground).

In 1938 the reported value of the products was $420,261 compared with $677,207 in 1937 and $768,742 in 1936. The drop in 1938, however, was not quite as great as these figures suggest, because the reported value includes only that of the calcined material sold plus the cost value of the calcined magnesitic dolomite used for further manufacture by the producing company. In former years the sales value of manufactured products, such as refractory bricks and other similar materials, was also included. Imports of magnesitic dolomite into the United States are shown later in the chapter in the section on dolomite.

Chosen.—It is reported[4] that the Korean Government has decided to permit private companies to mine magnesite at Zuisen, Kankyo Hokudo. These deposits, estimated to contain some 3 billion tons, have been closed in the past.

France.—According to L'Echo des Mines et de la Metallurgie (January 20, 1939, p. 23), prices and deliveries of dead-burned magnesite and magnesite brick from Austria were not affected by the union with Germany. France imports crude magnesite chiefly from Greece, and supplies were not particularly abundant at prices ranging from 31s. 6d. to 35s. a metric ton ($7.90 to $8.75) for small cargo lots. This material, which runs 45 percent MgO, is used for making metallic magnesium, magnesium chloride, and Sorel cement, and a little is used for magnesium nitrate. Quotations for caustic calcined magnesite, 85 to 90 percent MgO, ranged from £4 10s. to £6 10s. a ton ($22 to $32).

Union of South Africa.[5]—Magnesite has been produced continuously on a small scale in the Eastern Transvaal. The Althorpe mine is situated in the Barberton district about 10 miles east of Kaapmuiden, near the main road and railway to Lourenco Marquea, which is 100 miles away. There are other mines in the same district and near Lydenburg. The magnesite occurs in decomposed serpentines

[4] Mining Journal (London), Korean Magnesite Deposits To Be Topped: Vol. 202, No. 5376, Sept. 3, 1938, p. 83.

[5] Sinclair, W .E. ,Magnesite in South Africa: Min. Mag. (London), vol. 60 ,No. 1, January 1939, pp. 9-12.

and is exceptionally pure, averaging more than 97 percent $MgCO_3$, 0.85 percent $CaCO_3$, 1.20 percent SiO_2, and 0.48 percent Fe_2O_3. The yield in magnesite ranges from 10 to 25 percent of the ground removed by open-cut operations but may be higher in adit mining. After hand-sorting, much of the material is calcined in vertical shaft kilns using charcoal, and the product of the kilns is hand-sorted before crushing and bagging. Hitherto almost the entire output has been consumed more or less locally for flooring compositions, the gas being compressed and bottled for soda water, but owing to the purity of the material, the extent of the deposits, and the favorable situation of the mines for overseas shipments, an important export business may develop.

U. S. S. R.—In response to a request from the Bureau of Mines, the American Embassy in Moscow reports that no magnesite-production statistics have appeared in Soviet publications since 1933. The principal source is the Satka mine, which yields crude magnesite averaging 46.2 percent MgO. The output is used domestically as caustic calcined magnesite and dead-burned magnesite, although some of the latter is exported as grain and a minor amount as brick. Large-scale experiments have been made with the object of utilizing magnesite in the production of metallic magnesium. The capacity of the Satka works is about 80,000 tons a year.[6] The magnesite from these deposits, which are situated in the Western Ural Mountain district, is not quite as finely crystalline as the Styrian (Austrian) magnesite and is grayish white, but otherwise it is similar. Additional large deposits have been reported near Lake Baikal, East Siberia.

TECHNOLOGY

Under the cooperative research program at Pullman, Wash., supervised by H. A. Doerner, of the Bureau of Mines, three methods of commercially beneficiating low-grade magnesite have been developed and described.[7] Large-scale experiments may be required to determine which is most economical in practice. The first method involves selective calcination and mulling, followed by sizing. The second method is identical, except that the concentrate produced from treating low-grade ore is concentrated further by flotation. The third method requires no preliminary calcination but involves two-stage flotation. Attempts to float magnesite directly from low-grade ores gave poor results; owing to the difficulty of depressing talc, the grade of product and recovery were low. The highest-grade product for a given recovery was obtained by first floating away calcite and most of the siliceous minerals and then floating the magnesite away from the dolomite in a second step.

According to German Patent 655,793 (January 22, 1938)[8] magnesite may be floated directly from quartz, serpentine, and calcite by adding sodium oleate, water glass, and an acid metal salt, such as aluminum chloride.

[6] Lock, L., Development of the Magnesite Works in Satka during the First Five-Year Plan: Berg- und Hüttenmänn. Jahrbuch Montan. Hochschule Leoben, vol. 85, Nos. 3–4, 1937, pp. 350–361. (Ceram. Abs., vol. 17, No. 5, May 1938, p. 186.)

[7] Doerner, H. A., and Harris, D. L., Concentration of Low-Grade Magnesite Ores by Flotation: Bureau of Mines and Washington State Coll., Bull. P-1, 1938, 30 pp.

[8] Chemical Abstracts, Deutsche Xylolith-Platenfabrik: Vol. 32, No. 5, May 20, 1938, p. 3922.

A recent British patent (M. Levi, British Patent 473,953) covers a light-weight, heat-insulating material bonded by calcined magnesite and magnesium chloride (with or without sand, sawdust, or cement) and mixed with rice husks or hulls of other seed grains which are used whole to obtain air pockets.[9]

The development of chemically bonded magnesite brick has increased the useful range of magnesite linings for rotary cement and dead-burned dolomite kilns. Normally, where burning-zone linings of 70-percent alumina brick cost approximately $40 per foot, linings of unfired magnesite brick may cost $100 per foot. Where operating conditions are most severe, however, the additional cost has been more than offset by longer life and more regular operation.[10]

DOLOMITE

In 1938 sales of dead-burned dolomite by domestic producers dropped to 366,626 short tons valued at $3,095,355 compared with 617,706 short tons, valued at $5,217,833 in 1937, and 596,751 tons, valued at $4,887,243 in 1936. Most of the dead-burned dolomite is used for furnace bottoms, but substantial quantities of specially prepared material are sold to the glass industry under the trade name Calcimag. Single-burned dolomite or high-magnesium lime is classed in the Bureau of Mines statistics merely as "lime," although some of it is valued for its magnesium content. Increasing quantities of raw dolomite and high-magnesium limestones are used in agriculture to correct acidity and as a source of magnesium. The need for magnesium in the soil has been increasingly recognized in recent years.

Imports of dead-burned dolomite, reported separately since June 18, 1930, comprise principally impure magnesite or the so-called magnesitic dolomite dead-burned in Canada for steelworks refractories. This product, known as "Basifrit," usually contains 62 percent MgO and 21 percent CaO. By an ingenious method of calcination the usually troublesome lime content is rendered inactive, and it is claimed that this product is quite as useful for furnace bottoms as grain magnesite containing a maximum of about 4 percent CaO. In 1938 an American company, Basic Dolomite, Inc., having bought the formula and acquired a license to make a similar product, is reported to have begun its manufacture in the United States. Brucite, mined near Luning, Nev., is used as an admixture with dolomite to raise the magnesia content.

Originally the Canadian material was imported into the United States free of duty as "magnesite," but after the tariff act of 1922 levied a duty on magnesite it was reclassified and became dutiable under paragraph 214 of that act at 30 percent ad valorem. Under the first reciprocal trade agreement with Canada it was specifically described as "dead-burned basic refractory material containing 6 per centum or more of lime and consisting chiefly of magnesia and lime," and the duty was reduced on January 1, 1936, to 27½ percent ad valorem. In the second trade agreement between the United States and Canada, effective January 1, 1939, the minimum lime content was raised to 15 percent, and the duty was lowered further to 20 percent. The average lime content of all imports of magnesitic

[9] Science Abstracts, vol. 11, No. 4, April 1938, p. 113.
[10] Rochow, W. F., Modern Service Standards for Magnesite Linings in Kilns: Rock Products, vol. 41, No. 4, April 1938, pp. 82–83.

dolomite from Canada has been well over 15 percent and the average value has ranged from $22.62 a short ton (1932) to $25.79 (1934).

Dead-burned dolomite [1] imported for consumption in the United States, 1930–38, by countries

Year	Canada		Other countries [2]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value
1930 [3]	2,858	$74,847	166	$3,071	3,024	$77,918
1931	6,051	152,795			6,051	152,795
1932	5,120	115,808			5,120	115,808
1933	6,763	163,081			6,763	163,081
1934	6,473	166,912			6,473	166,912
1935	7,487	188,888	32	826	7,519	189,714
1936 [4]	13,893	348,799	35	879	13,928	349,678
1937	9,083	231,084			9,083	231,084
1938	2,875	67,340			2,875	67,340

[1] Reported as "dead-burned basic refractory material" since 1935.
[2] 1930, Czechoslovakia; 1935–36, United Kingdom.
[3] June 18 to December 31 only.
[4] Duty lowered from 30 to 27.5 percent on January 1, 1936.

BRUCITE

After sundry set-backs, brucite mining has just become established on a moderately extensive scale. The deposits near Luning, Nev., are of enormous extent and high purity; but transportation difficulties proved a handicap, and the material was not readily accepted as an interchangeable substitute for magnesite. Small quantities of this natural hydrate of magnesia, $Mg(OH)_2$, have been employed in petroleum refineries and for making magnesium compounds, but the important outlet at present is in the manufacture of furnace refractories, largely to increase the slag resistance of dolomite. Mining operations are conducted under lease from the United States Brucite Corporation by Basic Ores, Inc., a subsidiary of the principal consumer, Basic Dolomite, Inc. (845 Hanna Building, Cleveland, Ohio). For 1938 statistics on the production of brucite are included with those of "Other magnesium compounds." Previously they were reported only in a miscellaneous group, although the present operators who started work in October 1936 shipped substantial tonnages in that year and increased output materially in 1937. Prior to 1936 occasional carloads had been shipped for experimental purposes, but the quantity was inconsequential.

An excellent description of the Nevada deposits was published some years ago.[11] Much of the material runs less than 2 percent silica, less than 1 percent alumina, and about 0.75 percent iron oxide. Brucite occurs in conjunction with magnesite in Washington, and a small quantity has been used locally for carving into ornaments. The mineral has been noted at Hoboken, N. J., at Brewster, N. Y., and in Pennsylvania. Specimens have been found also in British Columbia, in Quebec, and in a few places in Europe, notably on certain islands off the coast of Scotland. Reported deposits in the Russian Caucasus may have commercial significance, but none are known that compare in size and purity with those in Nevada.

[11] Callaghan, Eugene, Brucite Deposits, Paradise Range, Nevada: Univ. Nevada Bull., vol. 27, No. 1, Jan. 16, 1933, 34 pp.

In 1938, however, brucite-bearing limestones were discovered at Rutherglen, Ontario, and at Bryson, Quebec, and this material is being considered for use in refractories and for making magnesium metal. Large deposits of hydromagnesite occur near Atlin and at other localities in British Columbia. According to a recent report, these may be utilized; the material is much superior to that found in the Reinosa district, Province of Santander, Spain, which has been mined more or less extensively notwithstanding its contamination with dolomite.

OTHER MAGNESIUM COMPOUNDS

The total quantity of magnesium compounds other than magnesite and dolomite produced from natural sources and sold or used in the United States was 70,733 short tons valued at $1,688,570 in 1938, an increase over the 64,777 tons valued at $1,578,527 reported for 1937 and the 63,841 tons worth $1,629,725 for 1936.

In 1938, as in former years, the principal items were magnesium chloride and sulfate recovered from brine wells and sea water. However, a little carbonate, oxide, and hydroxide also are recovered from these sources, and 1938 figures include for the first time the increasingly important output of brucite, which was produced commercially in Nevada as early as 1934, but the output was not included in the Bureau of Mines figures for magnesium salts until 1938. As shipments of brucite in those years were much less than in 1938 and are not very large even yet, this omission is not especially serious and may be corrected within a year or two with the consent of the producer.

Production of technical or basic carbonate of magnesium is more important even than that of the sulfate or chloride, but most of it is made from dolomite. In 1937 the Bureau of the Census reports the production of such carbonate, probably including the small quantity recovered from bitterns, as 6,505 short tons valued at $788,215 compared with 7,301 tons valued at $877,741 in 1935, the first year for which separate statistics are available. These figures, which cover seven establishments, do not include quantities (probably much larger) consumed at producing plants in making magnesia pipe coverings and other kinds of molded insulation. Total domestic productive capacity for the dry carbonate was estimated by the Tariff Commission as 13,500 tons in 1936 but subsequently has been increased. The production made for sale is used mainly in rubber goods, printing inks, paints, varnishes, pigments, and free-flowing table salt.

According to reports received by the Bureau of Mines natural magnesium chloride was recovered by the Dow Chemical Co., Midland, Mich., with various other products from its natural brines and by the Westvaco Chlorine Products Corporation from its sea-water bitterns at Chula Vista, Calif. Epsom salt (sulfate) was produced by the Dow Chemical Co. and by C. A. Kearney Co., which operates at Epso Lake, Tonasket, Wash.; the epsomite deposit at Medicine Bow, Albany County, Wyo., was not operated in 1938. Carbonate was reported by three companies: Plant Rubber & Asbestos Works at Redwood City, Calif.; Marine Chemicals Co., Ltd., at South San Francisco, Calif.; and Morton Salt Co. at Manistee, Mich. The Marine Chemicals Co., Ltd., also reported production of magnesium oxide and magnesium hydroxide (paste, powder, and milk of magnesia). As previously noted, brucite is mined at Luning, Nev., by Basic Ores, Inc.

Under the reciprocal trade agreement with the United Kingdom, effective January 1, 1939, the duty on imported precipitated magnesium carbonate, over 60 percent of which came from the United Kingdom in 1937, was reduced from 1½ cents to 1 cent a pound. Production of magnesium sulfate in Canada, all from the Kamloops district of British Columbia, declined to 470 tons valued at $9,400 in 1938 compared with 727 tons valued at $14,456 in 1937.

Magnesium compounds imported for consumption in the United States, 1930–38 [1]

Year	Magnesium chloride (hydrated and anhydrous)		Magnesium sulfate (Epsom salts)		Calcined magnesia		Magnesium carbonate, precipitated		Magnesium silicofluoride or fluosilicate	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1930–34 (average)	861, 138	$8, 267	8, 357, 367	$51, 761	389, 467	$69, 426	581, 958	$26, 662	47, 221	$2, 654
1935 [1]	50, 094	1, 095	3, 060, 883	18, 495	196, 264	36, 297	601, 459	27, 935	98, 037	6, 500
1936 [1]	31, 876	584	4, 334, 792	25, 008	238, 039	39, 098	754, 084	34, 396	(2)	(2)
1937 [1]	64, 300	1, 120	3, 905, 303	26, 771	217, 413	35, 643	1, 042, 900	51, 684	(2)	(2)
1938 [1]	81, 734	1, 572	1, 598, 316	12, 328	91, 545	15, 947	940, 069	53, 151	(2)	(2)

[1] In addition to the items reported separately, 3,668,091 pounds of calcined magnesium sulfate or calcined kieserite (not fertilizer) valued at $30,291 were imported in 1935, 5,439,651 pounds valued at $44,664 in 1936, 8, 233,726 pounds valued at $71,889 in 1937, and 6,386,795 pounds valued at $66,470 in 1938. Also 11,200 pounds of "manufactures of carbonate of magnesia" valued at $489 were imported in 1935; 13,056 pounds valued at $562 in 1937; and 5,600 pounds valued at $209 in 1938; none recorded in 1936.

[2] Not reported separately but included in the "magnesium salts and compounds, n. s. p. f."—372,291 pounds valued at $29,355 in 1936; 140,110 pounds valued at $20,462 in 1937; and 95,129 pounds valued at $17,146 in 1938.

A new magnesium product, activated magnesia, is claimed to possess properties that make it suitable for use as a decolorizing, neutralizing, or absorbing agent in industrial processes. It is made by heating precipitated magnesium hydroxide until 80 to 85 percent has been converted into oxide. The typical analysis shows 70.84 percent MgO, 14.38 percent $Mg(OH)_2$, 8.78 percent $MgCO_3$, 1.36 percent $MgSO_4$, and 3.42 percent $CaCO_3$, the remainder being silica, common salt, and oxides of iron and aluminum. The absorptive power of the dry powder for coloring matter is said to be 5 to 10 times that of bentonite or fuller's earth. It also speeds up chemical processes requiring a neutralizing agent. The activity of the product depends chiefly on the temperature of calcination and proper distribution of the heat.[12]

BROMINE

Notwithstanding the recession in most lines of business in 1938, the production of bromine in the United States, as reported by producers to the Bureau of Mines, continued to increase, as it has in every year since 1932. The 1938 output was 16,162 short tons valued at $6,610,056 compared with 13,100 tons worth $5,180,177 in 1937 and 10,305 tons valued at $4,038,438 in 1936. Not until 1923 did bromine begin to be used in the form of ethylene dibromide for making tetraethyl lead compounds for antiknock motor fuels, and as recently as 1925 the output was only 783 tons. The latest statistics, therefore,

[12] Chemical Trade Journal and Chemical Engineer, Activated Magnesia: Vol. 102, No. 2662, May 27, 1938, p. 440. (British Patent 483,096, Apr. 12, 1938.)

reveal an increase of almost 2,000 percent in 13 years. In the last 3 years the output of bromine has virtually doubled. Domestic demand for motor fuel of all types also has increased but only from 434,810,000 barrels in 1935 to 521,657,000 in 1938, or roughly 20 percent for the 3-year period. In the late 1920's the rate of increase in gasoline demand was about 20 percent a year, but it slowed down until in 1932 there was a slight recession. Although the uptrend was resumed later, the advance in 1938 over 1937 was barely perceptible, whereas the advance in bromine requirements was 23 percent.

Deposits of many minerals are worked out eventually, but bromine is mined from the inexhaustible reservoir of the ocean. Sea water contains only 1 pound of bromine in 2,000 gallons, yet it can yield even this small quantity economically by modern processes. In recent years the bulk of the domestic supply has come from the seaside plant at Kure Beach near Wilmington, N. C. The capacity of this plant has been increased repeatedly. Future growth is forecast in the following citation from a report of the Interstate Commerce Commission:

> Commercial operation of the dibromide plant at Kure Beach was begun in 1934 * * * the volume of traffic has ranged from 147,267 gallons of alcohol and 87,000 gallons of dibromide in the year ending June 30, 1934, to 818,855 gallons of alcohol and 1,343,000 gallons of dibromide in the 1938 fiscal year. Ultimately the movement of dibromide from Kure Beach to Carney's Point, N. J., is expected to reach 22,000,000 gallons. Dibromide also moves from Kure Beach to North Baton Rouge, La.

At consuming works the bromine compound is treated further with an alloy of metallic sodium and lead to make the tetraethyl lead fluid that is added in varying proportions to many of the better grades of so-called "ordinary gasoline" as well as to the special high-test motor fuels. On January 31, 1939, the Interstate Commerce Commission authorized a reduction of railroad rates on tank cars of ethylene dibromide from Wilmington, N. C., to Carney's Point, N. J.; the new rate is 26 cents per 100 pounds as against 89 cents formerly. The return rate between the two points on ethyl alcohol used in the process was reduced from 52 to 26 cents.

Other commercial sources of bromine in the United States include brine wells in California, Michigan, Ohio, and West Virginia. Although this country is the largest producer of bromine in the world and probably exports more than it imports, bromine is recovered in several other countries from brine wells and salt-works bitterns and is an important byproduct of the extensive potash industry that has sprung up in Palestine on the shores of the Dead Sea. In an effort to expand the demand for this bromine, the Daniel Sieff Institute at Rehoboth has investigated possible new uses of bromine derivatives as insecticides. Exports of bromine from Palestine are chiefly to the United Kingdom. Inasmuch as some of the product is warehoused at Port Said, statistics from different sources are not always comparable, but it would seem that total exports declined somewhat in 1938 after reaching a peak of 533 metric tons in 1937. Bromine-recovery plants utilizing salt-works bitterns are projected on a large scale in Italy and Japan, but so far no plants using raw sea water are known to have been built outside of the United States.

The average value of the domestic output of bromine in 1938, as reported to the Bureau of Mines by producers, was 20.4 cents a pound, or a trifle more than in 1937. This is a nominal figure, as most of the bromine was shipped in the form of ethylene dibromide, potassium and sodium bromide, and other compounds.

The aggregate value of imports of bromine and bromine products rose to $277,527 in 1938 compared with $225,268 in 1937 and $258,337 in 1936. The main item of imports, ethylene dibromide from Germany, advanced 23 percent over the 1937 quantity and almost equaled that for 1936. Late in 1938, however, the Bureau of Customs ordered assessment of a countervailing duty on this product of 3.775 cents a pound applicable only to imports from Germany and offsetting a bounty paid by the German Government.

Bromine and bromine in compounds sold or used by producers in the United States, 1934–38

Year	Pounds	Value	Year	Pounds	Value
1934	15, 344, 290	$3, 227, 425	1937	26, 200, 256	$5, 180, 177
1935	16, 428, 533	3, 483, 239	1938	32, 324, 116	6, 610, 056
1936	20, 609, 025	4, 038, 438			

Bromine and bromine compounds imported for consumption in the United States in 1938, by countries

Country	Ethylene dibromide		Potassium bromide		Other bromine compounds	
	Pounds	Value	Pounds	Value	Pounds	Value
Germany	1, 210, 005	$263, 459			733	$5, 110
Japan			42	$30		
Switzerland					527	8, 611
United Kingdom					10	317
	1, 210, 005	263, 459	42	30	1, 270	14, 038

CALCIUM CHLORIDE

Production and sales of calcium chloride and mixed calcium-magnesium chloride obtained directly from natural brines increased slightly in 1938 over 1937 but fell short of the all-time record of 1936. 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 table that follows, as the calcium comes from limestone and the chlorine mostly from sodium chloride that is elsewhere reported as salt in brine.

Imports of calcium chloride for consumption in 1938 were 1,647 short tons valued at $21,174, of which 1,605 tons valued at $20,703 came from Germany. The quantity imported in 1938 is the smallest since separate statistics became available in 1922 and compares with 2,205 tons worth $24,908 in 1937 and a maximum of 9,263 tons valued at $100,223 in 1928. Exports have fluctuated during the past decade from a high of 30,736 tons worth $525,179 in 1935 to a low of 15,425 tons and $362,658 in 1929. In 1938 they were 24,118 tons valued at $396,981.

In 1938 the Federal Trade Commission filed a complaint against four leading manufacturers and their Calcium Chloride Association, alleging price fixing and more specifically that they had (1) maintained a uniform zoning system for the United States; (2) suggested retail prices to their individual dealers and distributors; (3) exchanged information with reference to their prices and annual output; and

(4) made identical bids. It was alleged further that expenses of the association were prorated according to estimated yearly incomes, Dow Chemical Co. and Solvay Sales Corporation paying 32½ percent each and Columbia Alkali Corporation and Michigan Alkali Co., 17½ percent each, also that each of the other three companies contributes an additional $12,500 annually for right to use a manufacturing process patented by the Dow Chemical Co.

Later the Commission issued a cease and desist in respect to the four companies and closed without prejudice its case against the Solvay Process Co. (which owns the Solvay Sales Corporation) and the Calcium Chloride Association. According to its own statement, the activities of the association "consist among other things, of direction and control of advertising, publicity, research, and engineering promotion of the various uses of calcium chloride, which are principally for dust laying and stabilization in road building, ice control, curing concrete for roads, and treatment of dustless coal and brine for refrigeration."

Of these companies only the Dow Chemical Co. produces calcium chloride from natural brines. Other companies that reported production of calcium chloride or calcium-magnesium chloride to the Bureau of Mines include Great Lakes Chemical Corporation, Filer City, Mich.; Michigan Chemical Corporation, Saint Louis, Mich.; Rademaker Chemical Corporation, Eastlake, Mich.; Pomeroy Salt Corporation, Pomeroy, Ohio; J. Q. Dickinson & Co., Malden, W. Va.; Liverpool Salt Co., Hartford, W. Va.; Ohio River Salt Corporation, Mason, W. Va.; and Westvaco Chlorine Products Corporation, South Charleston, W. Va.

Calcium (calcium-magnesium) chloride from natural brines sold by producers in the United States, 1934–38

Year	Short tons	Value	Year	Short tons	Value
1934	76,719	$1,153,159	1937	101,547	$1,295,403
1935	83,546	1,039,103	1938	103,930	1,218,938
1936	125,911	1,909,908			

Calcium chloride imported for consumption in and exported from the United States, 1934–38

Year	Imports		Exports	
	Short tons	Value	Short tons	Value
1934	1,975	$26,271	30,715	$566,189
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	1,647	21,174	24,118	396,981

IODINE

The iodine industry of the United States began its second decade under auspicious circumstances. Started in 1928 and threatened with early extinction by progressive reductions in the price of Chilean iodine, it managed in 1938 to increase production, continuing the recovery that began in 1937. Imports of crude iodine, all from Chile, dropped sharply to 570,532 pounds valued at $464,303 from the record quantity of 1,967,148 pounds valued at $1,784,491 in 1937. Owing to the importers' policy of maintaining large stocks, these figures disclose nothing as to consumption trends; fluctuations in other years have been almost as violent.

Iodine produced in the United States, 1934–38

Year	Pounds	Value	Year	Pounds	Value
1934	284,604	$342,957	1937	299,286	$242,422
1935	245,696	248,654	1938	(1)	(1)
1936	233,925	212,635			

1 Bureau of Mines not at iberty to publish figures.

Crude iodine imported for consumption in the United States, 1934–38

Year	Pounds	Value	Year	Pounds	Value
1934	1,481,123	$2,134,979	1937	1,967,148	$1,784,491
1935	375,819	420,793	1938	570,532	464,303
1936	592,217	558,326			

Definite efforts have been made to expand demand for iodine, which is available in almost unlimited quantities in Chile as a byproduct of nitrate manufacture. Iodine has been added to salt and to municipal-water supplies as a preventive of goiter. It is an ingredient in a variety of medicines for combating various ills of man and beast, is a valuable laboratory reagent, has important uses in photography, and is employed in many other industries, but the principal prospect for largely increasing consumption is its use in animal feeding. During 1938 research workers at the University of Wisconsin reported that they had developed a permanent, simple means for stabilizing the iodine content of salt, limestone, and other mineral feed mixtures. In England the Nitrate Corporation of Chile, Ltd., announced the formation of an Iodine Education Bureau. This bureau will collect and disseminate scientific information on iodine and will collaborate with scientific institutions in experimental research to extend the knowledge of iodine, with special reference to its use in human and animal nutrition. It is not engaged directly in sales activities.

Although domestic production was begun in 1928 in Louisiana and later in California it did not become commercially important until 1930, when the General Salt Co., Long Beach, Calif., reported a substantial output; smaller quantities were produced by the Dow Chemical Co. and the Deepwater Chemical Co., Ltd. In 1932 the Jones Chemical Co., a subsidiary of the Dow Chemical Co., was producing iodine at Long Beach, Calif., and Shreveport, La.; in 1933 the name of this company was changed to Io-Dow Chemical Co., and its Louisiana operations were abandoned. The California plant of this company has operated continuously since it was started, and because of its superior processes and financial resources has become the dominant factor in the domestic industry. The only other producer in 1938 was the Deepwater Chemical Co., which resumed operations in 1936 under process patents controlled by Dow.

One of the recovery processes owned by the Dow Chemical Co. was patented recently (United States Patent 2,144,119, January 17, 1939). The iodine liberated from brine and removed therefrom by adsorption upon activated carbon or charcoal is precipitated on the anode of an electrolytic cell employing the compressed iodine-charged carbon as cathode.

The Chilean Nitrate & Iodine Sales Corporation reported sales of 832,290 kilograms of iodine for the fiscal year ended June 30, 1938; this figure compares with reported totals of 884,965 kilograms in 1936–37, 749,335 in 1935–36, and 462,474 in 1934–35. In June 1937 a 3½-year agreement was signed with Japan regulating Japanese exports, the exact amount to be determined in advance on July 1 of each year, in accordance with average selling prices of the preceding year, but in no event to be more than 70 or less than 25 tons. Under this agreement the Japanese firms were ordered by their Government to organize an export guild. France, which has a small domestic industry on the Brittany coast, using kelp, reestablished its import quotas on crude iodine on September 1, 1938.

The price of crude iodine was pegged for a number of years at the equivalent of almost $4 a pound. It was commonly assumed that Chilean nitrate producers could have sold it profitably at 25 cents a pound, but this was unnecessary as long as almost the only competition was from seaweed iodine costing $2 or $3 a pound. Following the development of domestic production from California oil-field waters, the price was dropped until on October 10, 1936, it was down to 81 cents a pound. In 1938, however, it was revised upward to $1.02. This is the world price quotation, other currencies being referred back to American exchange.

BORATES AND OTHER NATURAL SODIUM COMPOUNDS

Except for a sharp decline in borax shipments due partly to greatly reduced exports, recoveries of sodium compounds, other than common salt, from natural brines and saline deposits in the United States were well-maintained in 1938, faring better than the production of similar compounds from chemical plants. Sales of natural sodium sulfate increased slightly in quantity to 80,210 short tons valued at $596,812 compared with 80,053 tons valued at $599,266 in 1937. Although sales of natural sodium carbonates (chiefly soda ash but also bicarbonate and trona) declined 4 percent in quantity they increased 4 percent in value, amounting to 100,010 tons worth $1,235,328 as against 104,711 tons valued at only $1,191,485 in 1937. Production of sodium borates in 1938 totaled 219,513 tons valued at $4,570,316, a 39-percent decrease in tonnage from the 1937 figures (358,898 tons, $7,232,897). Owing to the importance of sodium borates the total for the group decreased to 399,733 tons valued at $6,402,456, or 26 percent less than the 1937 total of 543,662 tons worth $9,023,648.

Natural sodium compounds (other than NaCl) sold or used by producers in the United States, 1934–38

Year	Carbonates [1]		Sulfates [2]		Borates [3]		Total	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1934	88, 325	$1, 254, 113	16, 650	$148, 225	242, 500	$4, 822, 014	347, 475	$6, 224, 352
1935	93, 230	1, 173, 003	38, 706	275, 943	272, 967	5, 381, 560	404, 903	6, 830, 506
1936	102, 866	1, 106, 364	51, 608	336, 559	313, 759	6, 156, 123	468, 233	7, 599, 046
1937	104, 711	1, 191, 485	80, 053	599, 266	358, 898	7, 232, 897	543, 662	9, 023, 648
1938	100, 010	1, 235, 328	80, 210	596, 812	219, 513	4, 570, 316	399, 733	6, 402, 456

[1] Soda ash, bicarbonate, sesquicarbonate, and trona.
[2] Salt cake and Glauber's salt.
[3] 1934–37: Borax, kernite, and boric acid (calculated as borax), and a small quantity of colemanite; 1938: Borax, kernite, and boric acid (calculated as borax).

The entire output of sodium carbonates came from Owens Lake and Searles Lake, Calif. The Pacific Alkali Co., at Bartlett, and the Natural Soda Products Co., at Lone Pine (Keeler), operated at Owens Lake, Inyo County. At Searles Lake, San Bernardino County, the American Potash & Chemical Corporation, Trona, and the West End Chemical Co., Westend, also produced carbonates. All these companies except the Natural Soda Products Co. produce borax, and the American Potash & Chemical Corporation also is one of the largest producers of sodium sulfate, as well as of potash and lithium compounds, all as coproducts of Searles Lake brines. A credible estimate of production of soda ash from all domestic sources, including chemical plants using common salt as raw material, indicates a 20-percent decline in 1938 compared with 1937. The Bureau of the Census reported for 1937 a production for sale of 2,323,759 tons of soda ash valued at $33,768,770 and 142,161 tons of refined sodium bicarbonate valued at $3,606,271; in addition, 713,662 tons of soda ash was consumed in the same establishments where it was made.

The slight increase in domestic sales of natural sodium sulfate is all the more remarkable in the face of a sharp curtailment in imports of this material. Reflecting slower activity at southern kraft-paper mills, the total imports of salt cake dropped to 142,429 short tons from 220,176 tons in 1937; however, owing to the enormous increase in consumption of sodium sulfate during the last decade, the 1938 total was larger than that for any year previous to 1936. The bulk of the imports still come from Germany, but receipts from Chile increased substantially to 26,079 tons in 1938 from 17,120 tons in 1937 and 687 in 1936. No data are available as to domestic production from chemical works during the year under review. In 1937, according to the Bureau of the Census, the total output of salt cake from both chemical works and natural sources was 269,177 tons, of which 241,347 tons worth $2,367,616 were for sale. Sales of anhydrous (refined) sulfate were 21,797 tons valued at $312,285; Glauber's salt, 31,934 tons, $490,660; and niter cake, 22,983 tons, $521,601.

The Ozark Chemical Co., Tulsa, Okla., produces a large quantity of sodium sulfate as salt cake from deposits at Monahans, Ward County, Tex. This material was shipped from three new localities in 1938—the Arizona Chemical Co. (subsidiary of the American Cyanamid Co., New York, N. Y.) reported production in Texas from O'Donnell, Lynn County, and from Brownfield, Terry County, and the Salt Lake Sodium Products Co. made shipments from its plant near Salt Lake City, Utah. In 1938, as in former years, small quantities of Glauber's salt were produced in Wyoming near Rawlins, Carbon County, by the Iowa Soda Products Co. of Council Bluffs, Iowa, and at Casper, Natrona County, by W. E. Pratt. Saline deposits carrying both carbonates and sulfates of soda were reported under development in Washington, but no commercial output has been made as yet.

The greater part of the production of sodium borates is from the kernite ($Na_2B_4O_7 \cdot 4H_2O$) deposits of the Pacific Coast Borax Co. near Mojave, Kern County, Calif. However, as previously noted, borax also is produced in California in conjunction with other sodium salts from Searles Lake by the American Potash & Chemical Corporation and the West End Chemical Co.; it is also recovered from Owens Lake by the Pacific Alkali Co. at Bartlett. In the latter part of 1938 the Stanford Investment Co., Los Angeles, Calif., started mining borate

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minerals on Government lands near Tonopah, Esmeralda County, Nev., but no shipments were made. Exports of borax, after rising rapidly from 87,677 short tons in 1933 to a peak of 154,052 tons in 1937, dropped in 1938 to 77,519 tons valued at $2,642,446. This represents a reduction of 76,533 tons and accounts for 55 percent of the decrease in total shipments. The apparent quantity of borax available for domestic consumption (after deducting exports) dropped 31 percent but was greater than for any year prior to 1935.

DEEPER DRILLING AT SEARLES LAKE

Hitherto exploration of the remarkable saline deposits of Searles Lake has been confined to wells not more than 150 feet deep, and drilling has been stopped usually as soon as mud appeared in the cores or cuttings. Not long ago, however, William F. Foshag, curator of mineralogy for the Smithsonian Institution, Washington, D. C., suggested going deeper, and, with the cooperation of W. A. Gale, director of research of the American Potash & Chemical Corporation, holes were driven to the 300-foot level.

At present Searles Lake has the general appearance of a frozen waste, the dried salts forming an icelike crust so solid that an automobile can be driven over it. Only occasionally does the water level (brine) rise to the surface, but the porous salts usually are brine-soaked a foot or two below the surface, and wells 10 to 20 feet deep yield adequate flowage for pumping to the refineries. The top crust is chiefly common salt (sodium chloride) and varies in thickness, averaging perhaps 10 feet. Underlying this crust and extending to depths of 75 to 200 feet is a relatively solid mass of intermingled saline minerals that vary greatly in composition both horizontally and vertically. At greater depths, however, the proportion of bicarbonate increases, and just above the top of the clay is a thin bed of salts rich in borax which is disseminated irregularly higher up.

The latest prospect holes reveal that reefs of dry salts extend below and are interstratified with the clay. Dr. Foshag has found from his examination of the cores that at depth these reefs are almost pure bicarbonate of soda. Although common enough as a medicinal, household, and industrial chemical, this compound has never before been known to occur naturally as a mineral. At intermediate depths he has identified another mineral that likewise has been known heretofore only as an artificial chemical compound. This is a double sulfate and carbonate of soda termed "burkeite."

Although the quantity of salts in the upper layers of this deposit is more than ample to supply the needs of commercial operations for many years, the discovery of these enormous additional beds is of much scientific interest.

GEM STONES

By Sydney H. Ball[1]

SUMMARY OUTLINE

Retail sales of jewelry in 1938 totaled about $276,000,000, or 11.5 percent below the 1937 sales ($312,000,000) and slightly below those of 1936 ($280,000,000). Diamond rings, watches, and gold jewelry were the principal sales items. January was a fair month, February and March were poor, and May and June were better; July witnessed a slump from which a slight improvement was noted each month until the usual marked increase in December (sales in that month usually make up 25 percent of the year's sales). Although the Christmas sales of 1938 were almost as good as those of 1937, it was disappointing that no one of the later months of 1938 exceeded those of 1937 when, it will be remembered, trade was poor. The wholesalers' jewelry sales, in comparison, were 27 to 29 percent lower than those of 1937; consequently retailers' stocks at the end of 1938 were smaller than at the end of 1937. The demand for popular-price articles was better than for items in the higher price brackets, and the sales of costume jewelry were remarkably large.

Fashions in jewels.—Jewels continue to be worn in almost barbaric profusion, with large stones prominent. Gold, often in two colors, is even being worn in the evening and continues its gain at the expense of platinum. Silver jewelry also became popular in 1938. The motifs range from Hindu and Persian to French of the times of Louis XIV and of the late Directoire, as well as Victorian types and those of the nineties of the last century. Massive gold chains with pendant watches, crosses, or cameos, imposing necklaces and dog collars, and jeweled flowers and leaves are popular; jeweled hair ornaments and earrings, either long pendants or set close to the lobe of the ear, are imperative with the present coiffures. Tiaras are again worn, particularly in England. Much of the jewelry is flexible, permitting the stones to move with the wearer's movements. The ensemble is as much in vogue in jewels as in dress accessories. Costume jewelry ("junk" jewelry in the trade) is sold in quantity and may foster a love

[1] One of the consulting engineers, Bureau of Mines.

for the real article. The demand for colored stones grows, such jewelry requiring the use of countless small diamonds set pavé for contrast. The finer gems—diamonds, including "fancies," ruby, emerald, and sapphire—hold the center of the stage, but topaz and aquamarine are extremely popular, and the use of turquoise, moonstone, and amethyst and a host of other colored stones is increasing. Men are wearing more jewelry, featuring particularly star sapphire and ruby, cat's-eye, and the quartz gems.

Domestic production.—From the peak of American gem-stone production of $534,280 in 1909 the industry dwindled until 1934, when the value of the production was only about $3,000. Since then it has increased appreciably, and in 1938 the total output was perhaps $127,000; as the production is largely by individuals or partnerships and there is no canvass, exact figures are not available. The revival of the industry is due to two factors—the desire of tourists to purchase souvenirs and the increasing use of a variety of colored stones in jewelry. The demand by jewelers for American tourmaline, kunzite, and turquoise is insistent; the sales of Navajo turquoise-silver jewelry, for example, probably exceeded those of 1937 by some 15 percent.

In the Northwest and especially in Oregon, according to correspondence with H. C. Dake, are a large number of collectors of agate and other quartz minerals, many of whom are amateur lapidaries, while others send their "finds" to professional lapidaries, some 50 in number. It is estimated that in 1938 in Oregon material valued at $210,000 was collected; in Washington, $85,000; in Idaho, $35,000; and in Wyoming (largely moss agate) $8,000—a total of $338,000. Most of these agates remain in private collections, although it is believed that about one-fourth of the amount is sold to tourists. Turquoise valued at almost $30,000 was produced in 1938, and the United States is again the most important producer of this gem. Nevada produced over 80 percent of the total, Colorado 15 percent, and Arizona a small quantity. Southeastern Montana, as usual, produced a large amount of moss agate from the Yellowstone Valley which found a ready market among tourists. Scott's Rose Quartz Co., Custer, S. Dak., produced about 1,000 pounds of rose quartz. Considerable kunzite and a little tourmaline was produced by one firm in San Diego County, Calif.

William O. Vanderburg lists 39 turquoise mines in Nevada; in part he says:

> The production of turquoise and turquoise matrix in Nevada for 1938 was approximately 8,000 pounds, varying in value from $0.50 per pound for off-color and inferior grade material to $40 per pound for the finest quality. Due to the fact that the bulk of the production is made by individuals and firms who do their own cutting and polishing it is difficult to arrive at the value of the crude turquoise. Probably an average value for the crude material would be about $3.00 per pound. After the gems are cut and polished, sorted, and graded according to quality the value increases considerably.
>
> As a result of the increased demand for turquoise a number of deposits have been discovered in Nevada within the last 2 or 3 years. One of the notable features of turquoise mining in Nevada during the year was the shift in the bulk of the production from the deposits in Nye and Esmeralda Counties, centering around Tonopah, to the recently discovered deposits in Lander County with Battle Mountain and Austin as the producing centers. The principal producers of turquoise in Nevada in 1938 were the Burnham Bros., Guy Grannis, W. F. Godber (Western Gem & Jewel Co., Los Angeles), and Geo. McGinnis and associates, all of whom operated properties near Hickerson Summit, Lander County;

Lee F. Hand and C. T. Johnson, owners of turquoise properties in the Royston and Crow Springs districts, Nye and Esmeralda Counties; Ed. C. Smith, who operated the Smith mine, Cortez district, Lander County; D. J. Wilson (American Gem Co., Los Angeles), who worked a deposit in Copper Basin, northern Lander County, under a lease agreement with the Copper Canyon Mining Co.; and W. F. Godber, owner of the Reik mine in the Candelaria district, Mineral County.

The turquoise mined in Nevada varies considerably in color, ranging from green, blue-green, and various shades of blue to nearly white. The best quality is a rich blue color. Off-color material is hard to dispose of in the United States, although small lots of the inferior grades of turquoise have in recent years been sold to Germany. Turquoise matrix has an established popularity with the tourist trade, and some of its numerous varieties are characteristic of certain properties such as "black", "spider web", "gold", "brown", or "pinto matrix".

The turquoise mines in Nevada are not operated continuously; activity is restricted to the summer months, and the degree of activity is dependent on the demands of the jewelry trade. One of the most pronounced trends in Nevada turquoise mining in recent years is the tendency of the cutting establishments to acquire their own mines. Only a few years ago the principal outlets for crude turquoise were traders who made annual trips through the State, bartering articles of Indian craftsmanship for the crude turquoise, and in turn trading it to the Indians of the southwest.

The mining of turquoise is popular with miners of limited means because a minimum of equipment is necessary.

The discovery of emerald at Rye Patch, Pershing County, Nev., was widely heralded early in 1939 as the first deposit of emerald found in the United States, although deposits of the gem have long been known in North Carolina and other Eastern States. The Nevada emerald occurs as unusually deep-color marginal parts of beryl crystals in a pegmatite that intrudes limestone. The deep-color material makes up a relatively small part of the beryl, and most of it is flawed and not transparent; in consequence, the commercial importance of the find is doubtful. An abandoned emerald mine 15 miles south of Spruce Pine, N. C., was reopened early in 1938. North Carolina produced a little emerald matrix.

Near Hot Springs, Ark., there are at least seven producers of rock crystal, and these and others sell the product.

Among the other gem stones produced in the United States in 1938 were agatized wood (private lands surrounding Petrified National Monument, Ariz.); amazon stone (Teller County, Colo.); amethyst (North Carolina; and Larimer County, Colo.); aquamarine (North Carolina and Chaffee and Park Counties, Colo.); chrysoberyl (Jefferson County, Colo.); garnet (North Carolina; Custer, Chaffee, and Jefferson Counties, Colo.; and Emerald Creek, Idaho); fire opal (Owyhee County, Idaho); phenacite (Chaffee County, Colo.); ruby (North Carolina and Georgia); smoky quartz (North Carolina); and topaz (El Dorado County, Calif.; Thomas Range, Utah; and Teller and Park Counties, Colo.).

Charles H. Carpp and J. W. Kaiser operated the property of the American Gem Mining Syndicate, near Phillipsburg, Mont., in 1938. They produced 9,480 ounces of industrial sapphire valued at about $11,000. The Rocky Mountain Alabaster Co., Fort Collins, Colo., quarried about 50 tons of alabaster in 1938. Some Iceland spar of optical grade was produced in California.

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 1938 totaled $28,304,956, a decrease of 36 percent from 1937. Details are shown in the following table.

	Carats	Value
Diamonds:		
Rough, uncut, duty free	91, 515	$7, 077, 159
Cut, but not set, dutiable	330, 925	17, 016, 842
Pearls, not strung or set, dutiable		470, 304
Other precious stones:		
Rough, uncut, free		116, 924
Cut, but not set, dutiable		1, 698, 916
Imitation, except opaque, dutiable		1, 762, 458
Imitation, opaque, including imitation pearls, dutiable		18, 896
Marcasites, dutiable		143, 457

Tariffs.—There were few important changes in tariffs during the year. In the United States, under the provisions of the Czechoslovak Trade Agreement negotiated last spring, the duties on Czechoslovak imitation stones in the various brackets were reduced as much as 50 percent. Czechoslovakia was by far the chief source of such imitation stones, particularly rhinestones. The effect of the agreement was nullified when Germany occupied Czechoslovakia. Germany made barter agreements with some of the diamond-producing countries, without impressive results, however. A trade agreement with Brazil was canceled, and some of the others are stated to be inoperative.

Trade terms and judicial proceedings.—The Federal Trade Commission on March 18, 1938, issued its Trade Practice Rules for the Wholesale Jewelry Industry, a recodification of unfair methods of competition and other illegal practices in the trade. The use of the word "perfect" in describing a gem that under a 10-power loupe shows any imperfection is unfair practice; "perfectly cut" is not to be used to deceive the purchaser; the use of "diamond," "ruby," or other names is to be confined to these mineral species alone; "real," "genuine," and "natural" cannot be applied to synthetic or imitation stones; "blue white" cannot be applied to a diamond if at all off-color; articles must be as advertised; the adjective "synthetic" must be confined to synthetic stones. The Federal Trade Commission during the year issued a number of cease and desist orders against firms not living up to its trade rules.

In the fall, the Department of Commerce released texts of two commercial standards, covering gold and platinum.

The Jewelers Vigilance Committee continued its good work against shortcomings of the less ethical members of the trade; as for example, against a store that sold 0.72-carat diamonds as 1-carat solitaires. But even they are unable to do away wholly with the occasional switching of pieces of glass for diamonds, a case of this kind having occurred in Baltimore a few months ago.

Exhibits.—At the New York World's Fair jewels will be among the most attractive exhibits. In the House of Jewels, five of the leading New York jewlers will show their most beautiful jewelry, and De Beers & Associated Producing Cos. and the Diamond Corporation will exhibit rough and cut diamonds, an exhibit valued at over $5,000,000. In the Belgian pavilion, besides cut diamonds worth several millions, the art of diamond cutting will be shown. In Iraq's exhibit, goldsmiths from Baghdad will ply their ancient art. The Crown of the Andes, set with innumerable Colombian emeralds, is to be on exhibition. Boart Products, Ltd., is to have in the Hall of Mining and Metallurgy an instructive exhibit showing the industrial uses of diamonds. These exhibits should strengthen the gem consciousness of the American people and promote jewelry sales.

DIAMOND

The improvement in the diamond industry, which had continued for over 5 years, ended in September 1937; and 1938—with its wars, changes in the political map of Europe, and financial depression—was a poor year, as was to be expected with an industry that feeds on prosperity. The small demand and a large mine output increased stocks of rough diamonds for the first time in 6 years, although stocks of cut stones in the hands of cutters and retailers are not large. Prices of rough were firm, and those of cut diamonds tended to advance.

Share dealings.—The shares of diamond-mining companies listed on the London Stock Exchange had a relatively narrow market in 1938. Off to a good start, by January 15 quotations began to slip, and, except for a short rally in April, the decline continued until mid-July, after which prices strengthened for 2 months. The Czechoslovak crisis affected the market adversely, but this was followed by a sharp rise in October. For the rest of the year the market was inclined to be weak. The loss for the year was about 25 percent, the quotations of five representative stocks at the year end being 37 percent of their high (1927) and 370 percent of their low (1932). Of the more important stocks, 12 paid dividends.

Market.—The Diamond Trading Co. sold rough diamonds valued at about £4,000,000, only 44 percent of the sales of 1937. Sales in the third quarter were quite satisfactory, those of the first and fourth quarters fair, and those of the second quarter small. Good-quality large stones are still scarce.

Sales of polished stones were only about one-half those of 1937, the principal demand being for small goods and most of them of mediocre quality. June and July were the best months, as the Czechoslovak crisis interfered with the usual purchases for the Christmas trade. The United States, Argentina, India, and (early in the year) southeastern Europe were large purchasers.

As is usual in years of political crises, investment buying increased the sale of large stones, while the mode for pavé jewelry promoted the demand for small stones. Sales of industrial stones were large.

Growth of diamond-cutting industry.—Diamond cutting originated in India, where diamonds first were discovered, certainly well over a thousand years ago, and to Hindu lapidaries we owe the two basic principles of the art—the wheel and the use of diamond dust. Indeed, it was not until early in the seventeenth century that Europe wrested the cutting supremacy from India and its ally, Borneo, now for the past 2 centuries the most important of the eastern cutting countries. The Hindu cut too crudely for European taste, in part prompting the growth of the European industry. By the sixteenth century European artisans surpassed their eastern confreres in skill and were in demand at eastern courts.

The art was transmitted from India to Constantinople and later to Venice. Cut stones appeared in Europe between the eighth and thirteenth centuries. The art reached northern Europe at the turn of the fourteenth century, first at Nuremberg and Paris, and probably

Bruges only slightly later. Religious persecution drove the cutters from Bruges to Antwerp and soon thereafter to Amsterdam, later the asylum of persecuted Jews from Portugal, Spain, and Poland. Excluded from the guilds, they sought the free professions, among them diamond cutting. Diamond cutting appeared on the Western Continent in Brazil in 1802, and in the late sixties of the last century a cutting industry sprang up in the United States, small in roster but renowned for its superior product. The Government-subsidized South African industry, started in 1928, thrived for only 5 or 6 years.

The art of cutting has made steady improvement, slow at first but thereafter marked, particularly in our generation. Hindus, Venetians,

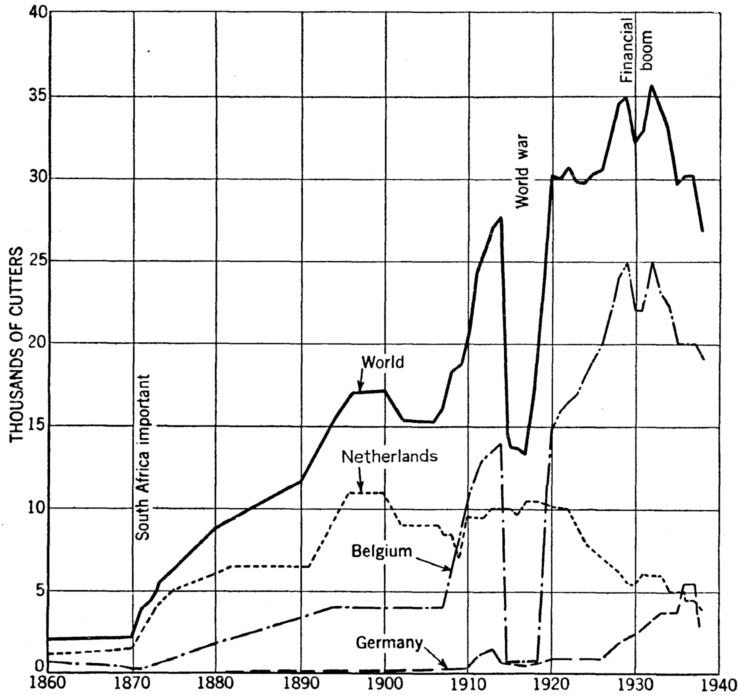

FIGURE 1.—Approximate number of diamond cutters in Belgium, Germany, Netherlands, and the world, 1860–1938.

Flemish people, both Catholic and Protestant, Netherlanders, Jews, and Americans have all made notable contributions to the craft.

An adequate supply of rough diamonds is necessary to the growth of the art. The Indian mines created the ancient industry of India and with their decline the industry died. Cutting in Borneo was fed first from the local mines, but now is supplemented by imported South African rough. Lisbon was an important cutting center while Portugal controlled the India trade, and the dominant position of the Netherlands as a cutting center was due first to her Indian trade and later to her monopoly of Brazilian rough. On the other hand, the French industry established by Cardinal Mazarin about 1650 starved to death owing to the lack of an adequate supply of rough diamonds. With the rough market centered in London, rough is now available to all cutters.

Bruges was the dominant center during most of the fifteenth century, Antwerp from 1483 to 1585, and then Amsterdam for over 3 centuries. In 1909 Antwerp regained the lead and has held it since, except for the World War period. During the past decade the growth of the craft in Germany has been phenomenal. That country, like Belgium, cuts small rough, while the Netherlands specializes in large.

During the financial boom of a decade ago, the industry became geared to prosperous times and since 1929 has been markedly overstaffed.

An ancient industry, the secrets of which were carefully guarded till 60 years ago; once a home industry, taught by father to son, it is now carried on in large factories. Started as a family trade, it has become big business. Sixty-five years ago the prince of artisans, the diamond cutter today, due to the unjustified growth of his craft, receives an indifferent and desultory wage. Unless great prosperity awaits in the near future, many a diamond cutter must seek employment in more profitable industries.

In 1500 A. D. there were some 600 cutters (India, 500; Europe, 100): 1660, 1,400 (India-Borneo, 400; Europe, 1,000): 1700, 950 (India-Borneo, 350; Europe, 600): 1770, 1,400 (India-Borneo, 300; Europe, 1,100); and in 1810 but 700, owing to the Napoleonic wars (India-Borneo, 300; Europe, 400). The growth of the industry since 1860 is shown in figure 1.

Cutting in 1938.—The diamond-cutting industry had a poor year, marked by little profit for the "masters" and increased unemployment among the men. Many of the latter were absorbed by other industries. Although the Belgian and Netherland centers lost ground, the German industry, which during the past decade has had such a phenomenal growth, suffered most severely.

Imports.—Diamond imports into the United States in 1938, by countries, were as follows:

Diamonds imported into the United States in 1938, by countries [1]

[Exclusive of industrial diamonds]

Country	Rough, or uncut			Cut, but not set		
	Carats	Value		Carats	Value	
		Total	Per carat		Total	Per carat
Austria [2]				11	$589	$53.55
Belgium	419	$23,311	$55.63	278,144	13,869,072	49.86
Egypt				1	135	135.00
France				767	67,608	88.15
India, British				87	20,456	235.13
Mexico				11	1,346	122.36
Netherlands				50,376	2,902,155	57.61
Switzerland				232	15,904	68.55
Trinidad and Tobago				8	439	54.88
Union of South Africa	91,096	7,053,848	77.43	591	65,990	111.66
U. S. S. R.				32	5,106	159.56
United Kingdom				665	68,042	102.32
	91,515	7,077,159	77.33	330,925	17,016,842	51.42

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.
[2] Figures cover period January 1 to May 5.

World production.—World production of diamonds (gem and industrial) in 1938 approximated 11,755,200 carats (2.351 tons) worth about $43,000,000. Compared with 1937 this is an increase of 22.5 percent by weight, without much variation in value, as the increase was largely in low-price industrials. As only Dutoitspan and Bulfontein of the South African pipe mines were operated, the alluvial mines produced 91.5 percent by weight and 70 percent of the value. The British Empire produced 31 percent by weight and 69 percent of the value. Of the total production, less than one-fourth by weight were gem stones.

The following table gives, as accurately as available statistics permit, world diamond production for the past 5 years:

World production of diamonds, 1934–38, by countries, in carats

[Including industrial diamonds]

Country	1934	1935	1936	1937	1938
Africa:					
Angola	452,963	481,615	577,531	626,424	[1] 651,000
Belgian Congo	3,331,360	3,812,023	4,634,266	4,925,228	[1] 7,205,300
French Equatorial Africa	------------	138	1,550	6,197	[1] 23,000
French West Africa	------------	------------	5,500	52,933	59,548
Gold Coast	2,391,609	1,349,847	1,414,677	1,577,661	1,315,000
Sierra Leone	68,633	295,483	616,200	913,401	[1] 900,000
South West Africa	4,126	128,464	184,917	196,803	[1] 140,000
Tanganyika	1,155	1,446	2,704	3,234	[2] 3,590
Union of South Africa:					
Mines	9,414	274,317	339,719	820,284	979,460
Alluvial	430,899	402,405	284,204	207,359	259,145
Total Union of South Africa	440,313	676,722	623,923	[3] 1,030,434	1,238,605
Brazil	[1] 42,500	39,100	136,462	238,606	[1] 150,000
British Guiana	44,821	47,785	41,067	35,958	[1] 35,000
Other countries [4]	4,000	5,500	6,000	6,000	34,200
	6,781,500	6,838,100	8,244,800	9,612,900	11,755,200

[1] Estimated.
[2] Exports.
[3] Includes a small quantity of diamonds recovered from retreatment of tailings.
[4] 1934: Netherland India (Borneo), India, Australia (New South Wales), Rhodesia, Nigeria, United States (California), and Venezuela; 1935: Netherland India (Borneo), India, Nigeria, and Venezuela; 1936: Netherland India (Borneo), India, Rhodesia, United States (California), and Venezuela; 1937: Netherland India (Borneo), India, Australia (New South Wales), Liberia, Venezuela, and Rhodesia; 1938: U. S. S. R., India, Borneo, New South Wales, Venezuela.

The increased production in 1938 compared to that of 1937 was due largely to an unusually large production of industrial stones by the Belgian Congo. South Africa increased its production about 20 percent, and the small outputs of French Africa and of miscellaneous sources increased markedly. The production of South-West Africa decreased about 26 percent and that of Gold Coast 17 percent.

Industrial diamonds.—More diamonds were used industrially in 1938 than ever before, although, as the proportion of crushing bort used increased, the dollar sales value probably was somewhat less than in 1937. The increase was due largely to the world-wide armament race and the need of a superabrasive to cut and shape hard alloy steels, as well as to the diversified use of diamond grains bonded in plastics and powdered metals. Over two-thirds, by weight, of the world diamond output is used in industry, mainly in the United States, Great Britain, Canada, Germany, and the U. S. S. R.

The demand for industrial stones was strong throughout 1938. As the finer stones are scarce, industry was forced to use the smaller stones and those of mediocre quality more and more. Carbonado (the Brazilian "black diamond") is now selling at a price that for certain purposes renders its use attractive. Prices were firm, with an upward tendency.

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, 1934–38 [1]

Year	Carats	Value		Year	Carats	Value	
		Total	Per carat			Total	Per carat
1934	526,007	$2,862,349	$5.44	1937	1,885,970	$6,542,365	$3.47
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				

[1] Compiled from records of the Bureau of Foreign and Domestic Commerce.

EMERALD, RUBY, AND SAPPHIRE

For the third successive year the lavish use of colored stones in jewelry depleted the store obtainable from old jewelry and brought nearer the time when the colored-gem mines will have to increase their scale of operation or a shortage will result. Barring a world war or a financial cataclysm prices must rise.

The Government-owned Muzo emerald mine, Colombia, was closed at least most of the year and early in 1939 was to be leased to private parties. The Government gives, rather naively, the theft of the better stones by the miners as the reason for the proposed change in management. The Chivor Emerald Mines, Colombia, operated on a restricted scale in 1938. The Bank of the Republic is said to have 24,000 carats of uncut emeralds stored in its vaults. The Cobra Emerald Mine, South Africa, in 1937 was operated by the African & European Investment Co. at a small profit. The official figures of the value of emerald produced in South Africa were £6,082 in 1936 and £10,838 in 1937. Victor Leinz and O. H. Leonardos report the occurrence of emeralds in detrital deposits in the State of Goyaz, Brazil, 20 miles southeast of the city of Goyaz. The stones are of good color but are badly flawed and lack transparency. The geological occurrence suggests affiliation with occurrences in the U. S. S. R., Egypt, and North Carolina—mica schists cut by pegmatites. The emerald mine at Habachtal (former Austria) is now in German territory.

In 1937 Burma produced 157,308 carats of rubies valued at £6,841 (20 cents a carat). Its rubies and byproduct sapphires were valued at £7,069 as opposed to £7,319 in 1936. Burmese miners in Cambodia produced a few rubies, sapphires, and zircons at the alluvial mines at Païlin and at Bo-Keo. The 1936 value was 1,880 piasters, three-fourths from the first locality and one-fourth from the second. Production, in carats, has been as follows: 1934, 450; 1935, 312; and 1936, 104.

India in 1937 produced 22,736 carats of sapphire, largely from Kashmir. The value as officially given is £1,682 in 1936 and £41 in

1937. The larger part of the Kashmir production is understood to be only usable industrially.

Sapphires valued at £1,410 were sold in the Anakie (Queensland) field in 1937 (£2,030 in 1936). Twenty-five men were engaged in mining, largely around Ruby and Sapphire, although some of them were attempting to locate new leads in the surrounding country. First blues, only a small percentage of the production, were in demand, but yellows and greens were difficult to sell. The Miners' Association sold largely in France, although a few fine stones were disposed of in America. Queensland produced gems, largely sapphires, from 1860 to 1937, inclusive, worth £643,156, the years of important production being 1907 to 1925.

The special committee appointed by the Government of Ceylon to investigate the gem-mining industry at first decided to establish a Government cutting works and a sales room at Colombo but finally recommended that the miners bring their stones to small depots where they could obtain the best current prices. The committee recommended further that an up-to-date map of the gemmiferous area be made, as it believes much illicit mining is being carried on and that there are several unexplored areas in Ceylon where gems may be found. Whether the central depots will be advantageous to the trade, time alone can tell. The Government could perhaps spend its efforts more advantageously in preventing unscrupulous merchants from selling synthetics and imitations as genuine stones.

LESSER GEMS

The all-time opal production of New South Wales is valued at £1,622,795, although for the 10 years, 1928–37, the average yearly production has been but £4,803. The 1936 production was valued at £6,110 and that of 1937 at £3,357. In the latter year over 97 percent came from Lightning Ridge, Grawin and White Cliffs supplying the remainder. The total opal production of Queensland from 1860 to 1937 is valued at £187,745, the big production being in the last 8 years of the nineties. In 1936 the production was only worth £150 and in 1937 had shrunk to £16. This came from Sheep Station Creek in the Quilpie district, where four men prospected part of the year. South Australia had sold opal to the value of £160,158 from 1916 to 1937. In 1937, £11,887 worth of opal was marketed, the most satisfactory year since 1920. The demand was better than usual, and hence mining was more active. Coober Pedy was the principal source; but two smaller fields, Mintabic and Andamooka, also produced. Opal artifacts and jade and crystal beads were found in a cave near Nakuru, Kenya, by Dr. L. S. B. Leakey, the distinguished archaeologist. The objects are believed to date from about 4,000 B. C. Dr. Leakey believes there were important opal mines in the vicinity.

In 1937 about 40 men gophered turquoise stringers at Nishapur, Iran. The owners, an Iranian mining company in Meshed, plan to drive a large tunnel 200 to 300 feet beneath the deepest old workings, which in turn are several hundred feet beneath the surface. The company cuts and mounts the turquoise in a small shop at Meshed. The same company also mines and sells salt; according to a letter from Lester S. Thompson, to increase the sale of the latter, a cheap turquoise ring is concealed in every five-hundredth 1-kilo package of table salt sold. A little turquoise (20 oz. worth £8 in 1936, none in 1937) is produced from time to time in the Brisbane district, Queensland.

The Afghanistan lapis lazuli contact-metamorphic deposits are worked by long tunnels whose sides are badly smoked, the rock having been broken by fire setting. It is believed there has been no mining for 10 years, the lapis lazuli sold coming from stocks on hand. Ernest F. Fox states that the best goes to Kabul, where it is cut.

In 1937, 2,952 cwt. of jadeite were produced in Burma, nearly double the previous year's production, although the value (£13,030) was lower (£13,412).

Burma also produced amber valued at £668 (£409 in 1936). Recent production of amber in Germany was, 1935, 112 metric tons; 1936, 332 metric tons; and 1937, 328 metric tons.

Vesuvianite of fine gem quality is produced to a limited extent at Laurel, Quebec.

Considerable amounts of jet are produced in the Province of Kompong-Thom, Cambodia (1934, 13,000 kilos; 1935, 24,000 kilos; and 1936, 24,270 kilos).

The United States annually imports from Brazil 5 to 6 tons of unusually fine quartz crystals absolutely essential in radios and in telephonic, telegraphic, and optical apparatus. Even if the finest crystals are used, the finished plates represent but a twentieth of the original. Minas Geraes exports its rock crystal to the United States, Germany, and Japan. Mining is primitive and rarely is carried to any considerable depth. Recently a fine rock crystal from Minas Geraes, Brazil, was sent to this country. It weighed 63 pounds and was sold for over $1,100, or about $18 per pound.

Amethysts occur in seams in trap rock near Scott's Bay, Nova Scotia, on the Bay of Fundy. The winter's frost each year forms new outcrops. Some of the amethysts are cut in Europe, returned to Nova Scotia, set in lockets or rings, and, together with rough crystals, sold to tourists. The trade has increased greatly in the last 6 or 7 years.

Several tons of rose quartz from pegmatic dikes in Minas Geraes, Brazil, are sold annually. Japan, China, and Germany are the principal markets, the best grades bringing $500 to $600 per metric ton. The State of Hyderabad, India, has widely distributed deposits of agate, plasma, and bloodstone.

The Iceland spar deposit at Hegustader, Iceland, is still operated as a Government monopoly.

As a result of 1938 political changes, the well-known Bohemian garnet localities and the Czerwenitza opal locality became German territory. It is understood that further working of the Jordansmühl (Silesia) nephrite deposits is to be regulated by the German Government.

In 1936, 13 companies were mining precious stones in Madagascar, although the production only was worth some $21,000. In 1936, 6.6 kilos of beryl, tourmaline, and kunzite were exported (4.5 kilos in 1935 and 9 kilos in 1934) and 31 kilos of feldspar and quartz gems, garnets, and similar stones (16 kilos in 1935, 23 in 1934). In addition much greater weights of industrial stones were exported. The demand is, however, so irregular that exports for a single year mean little.

The mines are small units, and the use of explosives is avoided lest the gems be ruined.

South-West Africa in 1937 produced 46.765 kilos of precious stones, largely tourmaline. Sales, largely to Germany, were, however, 688.987 kilos. In the first 9 months of 1938, 110.563 kilos were sold for £1,182. The stones included aquamarine, tourmaline, topaz, rose quartz, and chalcedony.

Brazil is the most important producer of the lesser gems, but figures on its 1938 production are not at hand.

SYNTHETICS

The Gemmological Institute of America in a study of synthetic emeralds finds the best method of distinguishing synthetics from real is the presence of irregular cracklike or wisplike markings in the synthetics, imperfections markedly different from the blemishes of emeralds.[2]

The Russian Precious Stone Trust is now making synthetics in its Leningrad laboratory, several of which, a sapphire of 292 carats and a ruby of 250 carats, are sizable.

The I. G. Farben-Industrie has a large synthetic-gem plant at Bitterfeld, Germany, which produces several thousand carats of synthetics a day. Some are sent to Oberstein for cutting, and others are used as jewels for watches and bearings for precision instruments.

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MINOR NONMETALS: CARBON DIOXIDE; GRAPHITE; GREENSAND; KYANITE, ANDALUSITE, AND DUMORTIERITE; LITHIUM MINERALS; MEERSCHAUM; MINERAL WOOL; MONAZITE; OLIVINE; SERPENTINE; STRONTIUM MINERALS; TOPAZ; AND VERMICULITE

By Paul M. Tyler [1]

SUMMARY OUTLINE

CARBON DIOXIDE

Continued progress was made in the production and use of solid and liquid carbon dioxide in 1938. The volume of business was approximately the same as in 1937, when the output (Census figures) of dry ice was 156,609 tons, valued at $4,618,937, and of liquid or gaseous CO_2 (including about 8,500 tons piped to dry-ice plants) 50,358 tons, worth $4,939,508. No radical new uses for either liquid or solid carbon dioxide were developed in 1938, but the use of the latter product for refrigeration continued to expand.

Natural-gas wells suitable for producing solid carbon dioxide are found in several States, and natural dry-ice plants have been built in California, Colorado, New Mexico, Utah, and Washington. Nevertheless, natural gas is a very small factor in the present-day volume of either liquid or solid carbon dioxide produced domestically, because the wells are so far from the population centers that consume the bulk of the products. As evaporation of solid carbon dioxide commences the moment it is made, the economics of distribution of this product differs from that of most commodities. Not only do freight charges add to the cost of distant shipment, but also the volume of the product diminishes more or less inversely with the time of exposure in transit or warehouse. Evaporation losses on large shipments are proportionately less than on smaller lots, but it has never proved economical to transport carbon dioxide to far-away markets. Byproduct gas from limekilns, cement mills, and metallurgical plants is more important than natural gas, largely because such plants are more likely to be situated in or near large cities or towns that afford markets. Over half the liquid carbon dioxide manufactured is made from the combustion of coke, coal, oil, and natural gas.

[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.

Geographic location is not the only economic factor. Even byproduct gas has comparatively little value unless waste power also is available. A properly designed combustion unit employing coke consumes virtually all the power developed by combustion to purify and compress the liberated gas to liquid and solid forms. However, the utilization of byproduct gas, particularly in localities where surplus power or cheap electricity is available, has been facilitated by improvements in methods of absorption and purification. As stated in Minerals Yearbook, 1938, fully 20,000,000 tons of CO_2 are liberated in a normal year at American cement and lime-burning plants alone, and there is little prospect of all this gas being captured successfully and sold at a profit. Both soda and potash solutions are used for absorption and purification of raw gases, and under certain conditions even better results are obtainable by using triethanolamine. The latter absorbent is the basis of the Girbotol process (United States Patent reissue 18958), which protects the use of aliphatic amines for the separation and recovery of acidic gases from gas mixtures. The cycle is identical with the orthodox potassium carbonate cycle, but the reagents have more capacity for carbon dioxide than does inorganic carbonate; moreover, they are more reactive and are easily regenerated. A letter from the Girdler Corporation, Louisville, Ky., states that the Girbotol process is used for the recovery of CO_2 in plants having a total installed capacity of 120 tons of carbon dioxide per day. This process is also used to remove carbon dioxide from gas mixtures, and in many plants the CO_2 is not recovered commercially. In fact, the quantity so wasted is considerably greater than the total capacity of plants that recover it commercially.

According to H. J. Duncan, of the Geological Survey, the Northwest Natural Gas Corporation at Klickitat, Wash., which has 13 wells producing from depths of 50 to 500 feet, is deepening one of its wells in the hope of obtaining an additional supply of gas. The plant now has a daily capacity of 6 tons, which retails at 3 cents per pound. Liquid carbon dioxide is bottled for soda-fountain consumption, and the company also has a contract to supply a large chain of stores with carbonated water. No treatment is necessary to purify the gas which needs only to be separated from entrained water.

According to State mineralogist Walter W. Bradley,[2] natural carbon dioxide gas was first obtained commercially in California in 1894 at the Santa Isabel shaft of the New Almaden quicksilver mine, Santa Clara County, where a drift on the 575 level was bulkheaded and the gas drawn out through a pipe, compressed in cylinders, and used to make soda water. Since 1933 carbon dioxide gas, produced from wells drilled on the edge of Salton Sea near Niland, Imperial County, has been converted into dry ice and shipped by truck to Los Angeles. The plant has a daily capacity of 10 tons but apparently has never operated at over half this rate.

In Germany dry ice is reported as being used successfully to preserve bakery products in transport or storage.[3] According to a later report from the office of the American commercial attaché in The Hague, dry ice is used quite generally in the Netherlands by large retailers and chain stores to protect confectionery, cakes, pastry, and bread-

[2] Bradley, W. W., California's Commercial Minerals: Min. Cong. Jour., vol. 24, No. 9, September 1938, p. 18.

[3] Bureau of Foreign and Domestic Commerce, World Trade Notes on Chemicals: Vol. 12, No. 47, November 19, 1938, p. 809.

stuffs, as well as ice cream. It is also used in household refrigerators. The use of dry ice in bakeries was introduced about 2 years ago because the Dutch Government passed a law prohibiting night work, thus preventing delivery of fresh bread in the early morning.

Liquid carbon dioxide derived from natural springs in Ecuador has been offered for sale in Panama.

Experiments at the University of Minnesota on the use of CO_2 for the preservation of certain fruits have passed the experimental stage, and for the last 3 years Minnesota growers have been shipping and selling strawberries and raspberries to dealers in surrounding States with considerable success. The berries are reported to be firmer in texture, brighter in color, and far freer from mold than those not gassed.[4] Reviving the idea of stimulating plant growth in greenhouses, and possibly in connection with newly developed methods of soilless cultivation, a University of Colorado professor[5] has called attention to the possibility of piping the gas from natural wells. He suggests that it may even be possible to flood open fields with it. The vast quantities of carbon dioxide available are indicated by the measurement of one gas well in Mexico that discharges 150,000,000 cubic feet of CO_2 daily, enough to make 9,000 tons of dry ice. The pressures at some wells approach 1,000 pounds per square inch. Earl S. Johnson,[6] of the Smithsonian Institution, recently has pointed out that increased light intensity as a means of forcing plants to grow faster is only effective up to a certain point because the carbon dioxide naturally present in air does not equal that required during accelerated photosynthesis. He states that the practical application of aerial fertilization with carbon dioxide and the source of supply of carbon dioxide in amounts adequate for field work are still unsolved problems, but that application of carbon dioxide to greenhouse culture appears more promising.

Summarizing the international situation, the foreign correspondent of a Canadian chemical journal[7] observes that the solid carbon dioxide business in the United States and Canada advanced to a certain point and then hesitated owing to complicated economic reasons, whereas in England where the application of refrigeration was less advanced the dry-ice business had a better chance to develop. A substantial tonnage of English CO_2 has been used in carrying fish to London from Scotland and on other overnight hauls for which dry ice is especially well-suited. On the other hand, little progress has been made in France and Germany. Norway, however, seems to have the most ambitious plans; there may be quite a development in shipping about Europe fish frozen with carbon dioxide.

GRAPHITE

Domestic graphite mining, which has been virtually dormant for several years, was animated in 1938 with the completion of a new plant at Morristown, N. Y., by the Long Valley Ore Co. The rock, which is said to run 20 to 25 percent graphite, is ground in a Hardinge ball mill and concentrated by flotation, the rougher concentrates being cleaned in a second battery of cells. The concentrates from the

[4] Industrial and Engineering Chemistry, Chemistry in 1938: Vol. 31, No. 1, January 1939, p. 5.
[5] Germann, F. E. E., CO_2 Wells May Yield "Air Fertilizer" for Crops: Science News-Letter, vol. 34, No. 7, August 13, 1938, p. 107.
[6] Oil, Paint, and Drug Reporter, Alcohol News: Vol. 134, No. 13, September 26, 1938, p. 19.
[7] Canadian Chemistry and Process Industries, vol. 23, No. 2, February 1939, p. 70.

cleaners are thickened to about 20 percent moisture, filtered, and dried. The product runs 85 to 90 percent carbon and is as pure as some of the Ceylon graphites. It is an excellent foundry facing and is also suitable for battery manufacture. A fair proportion of the material is flake, but the flakes are small and apparently unsuitable for crucible making. No detrimental impurities are found in the gangue, and the concentrates are free from all metallic elements except the usual percentage of iron oxide. The capacity of the plant is 15 tons a day but can be increased if demand warrants. The various California producers were idle in 1938, and the Western Graphite Co., Los Angeles, Calif., was dissolved as of December 1. The Graphite Corporation has announced its intention to open a new plant at Shelbyville, Tenn. At Clarkesville, Ga., the Southern Mining & Milling Co. increased its recovery of graphite as a joint product of its kyanite operations. The Texas Graphite Co., Llano, Tex., which was reorganized in 1936, began operations in 1937 and shipped a small amount of crystalline graphite for foundry facings in that year. No production was reported by the company during 1938, but operations may be resumed in 1939. Fully a dozen other companies are carried on the Bureau of Mines records as possible producers of crystalline graphite, but all of them reported that they did not produce during 1938.

As in former years the Carson Black Lead Co. shipped amorphous graphite from its mine near Carson City, Nev., to Oakland, Calif., for use in graphite paint. A somewhat similar operation is conducted by the Detroit Graphite Co., L'Anse, Mich. The leading manufacturer of artificial graphite is the Acheson Graphite Corporation, whose plant is at Niagara Falls, N. Y.

The Bureau of Mines is not at liberty to publish figures of graphite production.

Imports of graphite declined sharply in 1938, aggregating only 17,005 short tons valued at $372,039 compared with 29,593 tons valued at $752,315 in 1937 and 24,171 tons valued at $566,662 in 1936. Exports were 983 tons valued at $112,443 compared with 1,514 tons valued at $163,331 in 1937 and 816 tons worth $114,847 in 1936. Imports of leading items in 1938 (1937 figures in parentheses) were: Artificial graphite, 500 short tons valued at $19,870 (802 tons, $31,562); natural amorphous, 14,676 tons, $247,789 (25,354 tons, $512,162); Ceylon lump and chip, 41 tons, $3,074 (482 tons, $41,499); dust, 168 tons, $10,643 (321 tons, $17,600); and flake, 1,620 tons, $90,663 (2,634 tons, $149,492). All artificial graphite comes from Canada. In 1938 Mexico supplied two-thirds of the imports of natural amorphous graphite; shipments from Ceylon and Japan (Chosen) to this country were much less than in 1937. Imports of dust were furnished by Ceylon and Madagascar in roughly equal proportions. As usual most of the flake graphite was from Madagascar or France.

Under the trade agreement with the United Kingdom, effective January 1, 1939, the duty on amorphous graphite was cut from 10 percent to 5 percent ad valorem and that on Ceylon lump, chip, and dust likewise was halved, from 30 percent to 15 percent ad valorem. Effective June 15, 1936, the rate on flake graphite was reduced under the trade agreement with France; the previous rate, under the tariff act of 1930, was 1.65 cents a pound and the new rate is 30 percent ad valorem with the proviso that this shall not be less than 0.825 nor more than 1.65 cents per pound.

Prices of graphite tended to be somewhat lower in 1938 than in 1937, but the quotations did not differ greatly from those reported in Minerals Yearbook, 1938.

World production of natural graphite, 1910–14, 1925–29, 1930–34 (5-year averages), and 1935–37, in metric tons

[From data compiled by M. T. Latus]

Country	1910-14 (average)	1925-29 (average)	1930-34 (average)	1935	1936	1937
Argentina					18	(1)
Australia:						
New South Wales		12	18	30		
Queensland	1			14	23	12
South Australia			15			2
Brazil [2]	1	4	4	2		9
Canada	1,548	1,756	790	1,617	(3)	(3)
Ceylon [2]	27,226	13,618	8,677	14,131	13,731	17,660
Chosen [2]	[4] 11,846	18,484	23,721	44,698	40,914	39,800
Czechoslovakia		29,276	4,187	1,870	2,926	5,144
France	603	734	46			
Germany:						
Austria	34,094	19,083	14,653	19,490	21,710	18,158
Bavaria	8,660	17,548	21,333	21,663	24,290	23,544
Greenland						60
India, British	1,686	8	71	566	394	567
Indochina [2] [5]		289				
Italy	11,603	8,487	3,997	5,153	5,200	5,411
Japan	330	578	572	1,201	1,576	(1)
Madagascar [2]	4,750	14,141	6,111	8,046	8,570	12,387
Mexico	3,170	5,699	3,521	6,976	10,254	11,210
Morocco, French [2]		21	108	238	236	152
Norway	212		1,206	2,642	3,630	3,638
Spain		580				
Sweden	334			69	63	25
Union of South Africa	36	51	53	66	59	63
U. S. S. R.	(1)	3,992	[6] 32,333	83,700	(1)	(1)
United States:						
Amorphous	1,571	2,840	(7)	(7)	(7)	(7)
Crystalline	2,196	2,133	(7)	(7)	(7)	(7)
Total [8]	109,867	139,334	121,416	212,172	133,594	137,842

[1] Data not available.
[2] Exports.
[3] Production data not available; value reported as follows: 1936, $88,812; 1937, $125,343.
[4] Average for 1913–14; production data for 1910–12 not available; value reported as follows: 1910, $56,719; 1911, $65,727; 1912, $82,108.
[5] Concentrates.
[6] Average for 1932–34; data for 1930–31 not available.
[7] Bureau of Mines not at liberty to publish figures.
[8] Total of figures given in table only, probably incomplete.

Small amounts of graphite are produced in many countries, from Greenland (60 metric tons in 1937) to the Union of South Africa (63 tons in 1937). A half-dozen countries or more are fairly large producers, but in recent years none of them has challenged the supremacy of Ceylon and Madagascar as producers of high-grade graphite. Of a world total annual output of 200,000 tons, the U. S. S. R. recently has been credited with over 40 percent; Germany and Austria (combined), over 20 percent; Chosen, 20 percent; and Mexico, 5 percent. However, the bulk of the product in these countries is low-priced amorphous graphite, much of which is used only locally. Although the tonnage mined in Ceylon and Madagascar seldom exceeds 15 percent of the world total the value of their outputs is probably at least half the world total.

GREENSAND

The domestic production of greensand in recent years has been in New Jersey, chiefly by 3 companies although 1 or 2 other producers are more or less active. Shipments of refined greensand decreased in 1938 to 6,576 short tons valued at $152,000 compared with 9,734 tons worth $211,000 in 1937; the annual average for the 1925–29 period was 12,715 tons valued at $197,200. The valuation figures are partly estimated because a substantial part of the output is further processed by the producers and sold as water-softening compounds worth up to $115 a ton. Formerly considerable quantities were used for fertilizer, but this use has almost disappeared. The best grade of refined greensand (carload lots, screened and bagged) has been quoted in Engineering and Mining Journal at $20 per short ton, f. o. b. cars, for several years.

Properly processed greensand occupies a unique position in the water-softener field. Owing to its extremely high rate of exchange, it softens water as rapidly as the water can be forced through it. Since no synthetic zeolite yet seems to have approached this speed of reaction and since its speed of regeneration is equally great, greensand largely supplanted products prepared by a fusion synthesis. The historical development of the zeolite or base-exchange principle and additional information on the properties of greensand and other zeolite softeners are discussed briefly in Bureau of Mines Bulletin 328, which contains an annotated bibliography of the literature published before 1930.[8] This bulletin is out of print but may be consulted in libraries of most of the large cities of the United States. Additional information may be found in the trade literature issued by the filter companies that supply the processed materials.

Natural zeolites comprise a group of silicate minerals all of secondary origin and usually found in seams or cavities of basic igneous rocks. This group includes apophyllite, stilbite, chabazite, analcite, and natrolite, which, however, are of interest only to the mineralogists and are seldom, if ever, found in minable quantities.

Most clays are capable of some zeolitization, and a claylike material from one of the Faroe Islands (Denmark) flakes down and is suitable for use in water softeners.

Indicative of the growing market for water-softening chemicals are the Bureau of Census reports of shipments of water-softening apparatus for domestic use, which have increased steadily from a monthly average of 273 units in 1933 to 1,066 in 1937; the monthly average for 1938 was 1,027 units.

KYANITE, ANDALUSITE, AND DUMORTIERITE

Notwithstanding the depressed condition of many of the consuming industries, domestic production of kyanite showed further progress in 1938, although imports of "kyanite and sillimanite" decreased to 3,964 short tons valued at $32,458 compared with 7,674 short tons and $79,410 in 1937, the first year for which statistics are available. British India has been almost the only foreign source of kyanite or its allied minerals sillimanite, andalusite, and dumortierite. However,

[8] Shreve, R. N., Greensand Bibliography to 1930 (Annotated), with a Chapter on Zeolite Water Softeners: Bureau of Mines Bull. 328, 1930, 78 pp.

kyanite schists in the U. S. S. R. are reported [9] to be suitable for refractories, and in December 1938 the Bureau of Mines was asked to advise regarding possible markets in the United States for South African andalusite averaging 57 percent Al_2O_3 and containing 1.1 percent Fe_2O_3 and 0.1 percent MnO. These deposits, which were described in a bulletin [10] of the Department of Mines at Johannesburg, occur in the Zeerust and Marico Districts of western Transvaal, some of the best material being found along the Doorn River (part of the Marico drainage system) where it flows over the lowest horizons of the Pretoria series.

According to a report of the Imperial Institute (Bull. 36, pp. 493–498) recent discoveries in Nyasaland suggest that alternative supplies of kyanite may be available from that country. Deposits in British East Africa may be regarded as potential sources, although perhaps at present material could not be landed at United Kingdom ports at less than £5 a ton. Samples of good-quality kyanite have been received at the Imperial Institute from Kenya, and the producer claimed that he could make shipments at the rate of 100 tons a week. In Western Australia kyanite is abundant in the Chittering Valley 40 miles from Perth.

The leading domestic producer of kyanite, Celo Mines, which boosted capacity to 15 tons of kyanite concentrates a day, operated steadily during 1938 although at a reduced rate owing to the shrinkage in sales to refractory manufacturers. Further major changes in the flow sheet are contemplated in order to yield some entirely new products, including an especially low-iron kyanite that may be used directly in electrical porcelain glazes and as an ingredient in glass. Byproduct garnet has become an important credit item, and experimental work has been conducted to devise means of utilizing the mica which, however, is mostly biotite. The quartz at this property is thermally luminescent, and it is thought that some day this peculiar phenomenon may find a useful application.

The Phosphate Recovery Corporation pilot mill on Baker Mountain near Pamplin, Va., was remodeled again. Owing to the losses experienced by straight gravity concentration, wet tabling has been supplemented by froth flotation, and bleaching tests have been made to lower further the iron content of material drawn from certain parts of the deposit.

At Clarkesville, Ga., the Southern Mining & Milling Co. produced kyanite from schists by its mulling process recently patented (U. S. Patent 2105597, January 1938) by Philip S. Hoyt. E. C. Noble, New Florence, Mo., reported that he was building a mill near Clarkesville, Ga., to produce both kyanite and vermiculite from schist. B. J. Lachmond shipped a few cars of kyanite from Henry Knob, S. C. Other domestic producers include the Vitrefrax Corporation of Los Angeles with mines at Ogilby, Calif., and the Tillotson Clay Products Co., Los Angeles (mines in California and Nevada). The latter organization has produced andalusite near Hawthorne, Mineral County, Nev.

The leading andalusite mine in the world, however, is operated by Champion Sillimanite, Inc., in the White Mountains, Calif. This

[9] Borisov, P. A., Kyanite of the Kola Peninsula and the Problems of Highly Refractory Materials: Razvedka Nedr. 1937, No. 12, pp. 1–5. (Ceram Abs., vol. 17, No. 7, July 1938, p. 262).

[10] Partridge, F. C., The Andalusite Sands of the Western Transvaal: Union of South Africa Dept. of Mines, Geol. Series Bull. 2, 1934, 16 pp.

company is a subsidiary of the Champion Spark Plug Co., Detroit, Mich., whose laboratory-porcelain and thermocouple protection-tube business has been sold to the Coors Porcelain Co., Golden, Colo. The company also has a dumortierite property in Oreana, Nev., which is credited with a total output of 4,500 tons up to and including the 1938 production. This figure is probably also the aggregate world output to date. The andalusite mine is high on the west slope of White Mountain Peak above the little town of Laws, Inyo County, Calif., close to the Nevada line and not far from Bishop, Calif. The mineral occurs in irregular lenses largely on the footwall of the quartz monzonite dike. The original outcrop was on the walls of a cliff so steep that miners at first had to be lowered on ropes. The ore is hand-sorted and transported by muleback to shipping bins 3 miles away and 3,000 feet lower.[11]

Production figures for kyanite and related minerals are not available.

The function of dumortierite in spark-plug insulators and electrical porcelain is to increase the electrical resistivity and widen the burning range. Dumortierite refractories swell slightly when fired; however, contrary to published statements dumortierite is not used in spark-plug cores to overcome any tendency of andalusite to sag but because it is almost indispensable in the product. Dumortierite is valuable for use in such places as the spout for a glass tank, where it seems to resist the eroding effect of the glass remarkably well.

Prices of kyanite were reduced at the beginning of 1939. For regular refractory grades the cut was as much as 40 percent; for high-grade white-burning products it was less. Throughout most of 1938 Celo Mines was offering a 98-percent kyanite, white-burning concentrate, calcined and ground to 325-mesh and carrying only about 0.1 percent Fe_2O_3.

LITHIUM MINERALS

The Bureau of Mines has resurveyed the Nation's resources of low-grade lithium ores and has developed methods for concentrating them and extracting lithium compounds, thereby demonstrating that raw-material supplies afford no handicap to rapid expansion in commercial utilization of the metal and its salts. Only a few years ago lithium was thought to occur only in small, widely scattered deposits and consequently seemed destined to remain one of the rarer elements, but now it may be regarded as one of the cheaper, readily available metals. In 1938 an interesting report [12] on lithium occurrences in Maine and Massachusetts was published. A good description of the Harding mine in Taos County, N. Mex., which produced as much as 12,000 tons of lepidolite before it closed in 1930, has been issued by the State Bureau of Mines and Mineral Resources.[13] Although the ore shoot that was worked in the past may be mined out, a well-conducted exploration program probably would disclose other shoots that could be exploited.

The mine production of lithium minerals in the United States decreased sharply in 1938, but this was more than offset by the recovery of lithium from a new and heretofore unsuspected source,

[11] d'Arcy, N. A., Jr., A Rocks and Minerals Outing to Owens Valley, Calif.: Rocks and Minerals, vol. 14, No. 3, March 1939, p. 73.

[12] Hess, F. L., and Ralston, O. C., Lithium in New England: Eng. and Min. Jour., vol. 139, No. 6, June 1938, pp. 48-49.

[13] Just, E., Geology and Economic Features of the Pegmatites of Taos and Rio Arriba Counties, N. Mex.: New Mexico Sch. Mines Bull. 13, 1937, pp. 26-30, 33-35.

namely, as a byproduct of the complex brine-refining operations in California (at Searles Lake) which yield potash, sodium sulfate, soda ash, and borax as coproducts. The total production of lithium compounds, as given by producers to the Bureau of Mines, aggregated 892 short tons valued at $329,088 compared with 1,357 tons valued at $36,206 in 1937 and 1,241 tons worth $34,273 (revised figures) in 1936. Although the tonnage was much less in 1938 than in earlier years, the value was almost 10 times as great because the average lithium content was increased greatly owing to inclusion of the lithium phosphate recovered at Trona, Calif., by the American Potash & Chemical Corporation.

Three producers reported shipments of lithium ores from South Dakota in 1938. Amblygonite, lepidolite, and spodumene were shipped from Keystone, Pennington County, where the Etta mine was operated by the Maywood Chemical Works and the Ingersol mine by the Black Hills Keystone Corporation. Amblygonite was also shipped from the Tinton mine of the Black Hills Tin Co., at Tinton. Small quantities of lithium ores were produced from other properties in South Dakota and North Carolina but not shipped.

Lithium compounds produced and shipped in the United States, 1929–38

Year	Number of producers	Short tons	Value	Year	Number of producers	Short tons	Value
1929	2	(1)	(1)	1934	5	719	$20,980
1930	5	1,797	$56,327	1935	4	1,154	26,834
1931	2	(1)	(1)	1936	6	[2] 1,241	[2] 34,273
1932	2	(1)	(1)	1937	7	1,357	36,206
1933	6	504	12,997	1938	4	892	329,088

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

The first production of lithium ore in Canada came from deposits at Bernic Lake, Manitoba, in 1937. The entire output (mainly lepidolite and spodumene) valued at $1,694 was shipped to the United States. The Canada Bureau of Mines reported a discovery of spodumene near Falcon Lake 85 miles east of Winnipeg, which carries enriched portions that are considered minable. Lepidolite from the Silver Leaf deposits in Manitoba contains substantial quantities of cesium and rubidium. Amblygonite, as well as spodumene and lepidolite, was being prospected in 1938 in the Lac du Bonnet district in Quebec.

South-West Africa and France are the largest producers of lithium ores outside of the United States. Formerly amblygonite was mined extensively in the Spanish Peninsula, but in recent years shipments from Spain and Portugal have virtually ceased. During the first half of 1938 no lepidolite was produced in South-West Africa, whereas in the similar period of 1937 there was an output of 745 long tons averaging 3.75 percent Li_2O; however, the output of amblygonite (8.5 percent Li_2O) jumped to 170 tons compared with 35.7 tons. These minerals, all produced at Jooste lithium mine, are exported to the United Kingdom, France, Germany, and the United States. During the entire year of 1937 the output of lepidolite was 1,030 tons and of amblygonite 220.7 tons. In 1936 no amblygonite was shipped, but the lepidolite output was 852 tons. Export valuations for lepidolite declined in 1938 to less than £2 10s. (about $12.50) a long ton as against £2 15s. in 1937; the reported value for amblygonite increased slightly to almost £10 or about $50 a ton.

The increase in the use of lithium chloride as an air desiccant has been disappointingly slow. Although this outlet and various other uses of the salts or the metal itself continue to afford promise of much greater development, interest recently has centered more upon ceramic uses. According to Betz [14] the chief advantages of lithium in ceramic formulas are: (1) It is a powerful flux especially in conjunction with feldspar; (2) in certain glasses of low thermal expansion it permits the use of much less alkali; (3) it enables the production of glasses of high electric resistance and desirable working properties; (4) a high Li_2O content aids in producing glasses that transmit ultraviolet light; (5) it has a strong mineralizing effect in ceramic bodies; (6) replacing PbO by Li_2O reduces the tendency for a glaze to vaporize; and (7) it lowers the maturing temperature and greatly increases the fluidity and gloss of enamels and glazes.

Spodumene expands in whiteware bodies, and if properly controlled this expansion may offset shrinkage and other production troubles. Lepidolite hardens and toughens clear glass and lowers the expansion coefficient. Formerly lepidolite was used chiefly in place of cryolite in opal and white glass, but recently it has been receiving attention as a constituent of heat-resisting, low-expansion, and nonshattering glass; it is a powerful flux and brings potash and fluorine as well as lithia and aluminum into the bath.

According to Preston [15] variation in the composition of natural lithium minerals has led to the use of chemically prepared salts in ceramic work; the most important of these is the carbonate, which has wide application in the production of better-quality glazes. Addition of 1 percent or more lithium carbonate to dinnerware and sanitary-ware glazes increases gloss, and in electrical porcelain this compound produces a glaze of high strength and weather resistance. In glazes, as well as in glassmaking, the high fluidity imparted by lithium additions increases the workable range of other desirable addition agents. To obtain a similar degree of fluidity requires smaller proportions of lithia than of potash or soda. An interesting development is the use of molten lithium nitrate as an etching agent on glass. Glasses of high lithia content possess greater transmission of ultraviolet light.

Single crystals of lithium fluoride are grown up to 2,200 grams in weight. These afford an excellent substitute for optical fluorite which is becoming scarce, especially in large sizes. In 1938 the Harshaw Chemical Co.[16] undertook to manufacture these new crystals, employing the technique originally developed in the physical laboratories at Harvard University and the Massachusetts Institute of Technology. Large crystals of rock salt and sodium nitrate also are produced for optical uses.

MEERSCHAUM

Apparently world supplies of crude meerschaum in recent years have come exclusively from the Eskishehir deposits in Turkey. Imports into the United States in 1938 were 3,559 pounds valued at $9,221

[14] Betz, Geo. C., Lithium Minerals and Compounds in Ceramics: Jour. Am. Ceram. Soc., vol. 21, No. 5, 1938, pp. 189–191; Chem. Abs., vol. 32, No. 13, July 10, 1938, p. 5169.
[15] Preston, E., Lithium in Glass and Ceramics. Foote-Prints, vol. 11, No. 1, July 1938, pp. 1–15.
[16] Industrial and Engineering Chemistry, News Ed., vol. 16, No. 21, November 10, 1938, p. 584.

compared with 3,687 pounds worth $12,681 in 1937. The average import valuation of $2.59 in 1938 compares with $3.44 in 1937, a minimum of $1.36 in 1924, and a maximum of $4.09 in 1934.

According to a recent report to the Bureau of Mines a commercially promising deposit of meerschaum has been found in the State of Washington. A few scattered deposits had been known previously in the United States. Domestic production has totaled perhaps 1,000 tons, chiefly from a mine near Sapillo Creek, N. Mex., which ceased to be worked about 1914.

MINERAL WOOL

Notwithstanding a further large increase in productive capacity and some improvement in contracts for residential and certain other kinds of building construction, the output of mineral wool in the United States apparently dropped in 1938. Actual figures are not available, but those in close touch with the industry have estimated that the reduction was 20 percent or more compared with 1937. A leading development was the construction of a huge new plant by Johns-Manville Corporation near Long Beach, Calif. The raw material for this plant is wollastonite mined in Rademacher district near Randsburg. Among other new plants are those of the Edwards Insulation Co., Temple, Tex.; the Northern Rock Wool Co., Pontiac, Mich.; the P. J. Sonner Burner Co., Winfield, Kans.; the Kentucky Stone Co., Mullins, Ky.; and the Ohio Valley Rock Asphalt Co., Summit, Ky. Several existing plants were modernized and expanded; by the simple process of adding another tap hole, the capacity of individual cupolas has been doubled. J. R. Thoenen, of the Bureau of Mines, estimates that there are about 160 cupolas capable of making rock or slag wool in the United States; at least 60 companies operate 70 or more plants in various parts of the country. Productive capacity is approximately 600,000 tons annually, whereas the output in 1938 did not exceed 400,000 tons and possibly was much less. It is estimated that the total output is now divided almost evenly among the three types of products—nodulated (granulated) wool, loose wool, and batts.

The only available statistics of the mineral-wool industry are the biennial figures of the Bureau of the Census, which has reported a total value of $8,279,374 for the production of "mineral wool (other than asbestos) for building insulation" in 1937 compared with $7,786,285 (revised figures) in 1935, $1,714,171 in 1933, $2,873,230 in 1931, and $2,377,324 in 1929. A break-down of the latest figures shows an increase in value for rock wool from $3,361,446 in 1935 to $4,989,117 in 1937 and for slag wool from $1,184,946 to $2,474,295, whereas for "other" mineral wool there was a sharp decline from $3,239,893 in 1935 to only $815,962 in 1937. Glass wool, however, was included in still another blanket classification and the exact nature of the material covered in this category is not revealed.

The production of glass wool and fibers has increased greatly, and their uses have become more diversified. Of wide interest is the employment of glass "mulching wool" for the winter protection of plants. Supplied in strips, 2 inches thick, like cotton batting, it affords better protection than snow, weighs only one-fourth as much, and lasts 3 winters. In 1938 the two domestic producers of glass fibers, the Corning Glass Works and the Owens-Illinois Glass Co., combined their business in the glass-fiber field under the name of the Owens-Corning Fibre Glass Co., a jointly owned but otherwise independent corporation.

MONAZITE

Imports of monazite into the United States increased slightly in 1938 to 456 short tons valued at $18,210, of which 339 tons valued at $14,402 were from British India, 110 tons valued at $3,421 from Brazil, and 7 tons valued at $387 from the United Kingdom. In 1937 the imports were 336 tons valued at $13,579 compared with 607 tons and $25,324 in 1936. No domestic output has been recorded since 1925. Prices, as reported by the Engineering and Mining Journal, remained unchanged at $60 to $75 a short ton (basis, 8 percent ThO_2) until late in the year when they narrowed to $60 to $70 a ton.

OLIVINE

Dunite deposits of commercial importance are found in California, Washington, and North Carolina. The North Carolina deposits are the largest and contain the most adaptable material. They contain probably 50 to 100 million tons of olivine suitable for the manufacture of forsterite refractories and recently have produced as much as 600 tons a month, a figure that could promptly be increased to keep pace with any reasonable expansion in demand. Exact figures are not available, but shipments in 1938 declined slightly, being estimated at less than 2,000 tons. There are two quarries, both in Jackson County, N. C.

Greaves-Walker and Stone [17] have summarized available information on olivine and reported their successful search for suitable binders for olivine refractories.

SERPENTINE

Attractively colored and veined serpentine is marketed as verde antique for building trim and various ornaments. Chips may be used in terrazzo or sold as roofing granules. Recently, however, the Bureau of Mines has received a number of inquiries as to possible other uses, especially for ground serpentine.

Enormous quantities of serpentine, much of it pulverized into an almost impalpable powder, are blown out of the chrysotile asbestos mills in Canada and Vermont. However, as yet, asbestos dust has found only a limited use. It has been employed in conjunction with short-fiber asbestos in various cements and to a very small extent as a filler in miscellaneous products. Recent inquiries seem to be regarding possible use of the material as a refractory, although, as has been pointed out frequently, ordinary serpentine is not a particularly high-melting material and suffers from the further disadvantage of containing much combined moisture that is driven off at a relatively low temperature. Moreover natural serpentine rarely approaches the theoretical formula, $3MgO.2SiO_2.2H_2O$ with 43 percent MgO. Ordinarily it contains 2 to 8 percent iron oxide and substantial quantities of silica, alumina, and other impurities. Both because of these impurities and because of the relatively large content of combined water, it would seem impossible to substitute serpentine success-

[17] Greaves-Walker, A. F., and Stone, R. L., The Production of Unfired and Fired Forsterite Refractories from North Carolina Dunites: North Carolina State Coll. Eng. Exp. Station Bull. 16, September 1938, 123 pp. (Abstracted in Bureau of Mines Mineral Trade Notes, vol. 8, No. 2, Feb. 20, 1939, pp. 19-20).

fully for other magnesium silicate minerals of somewhat similar composition, such as olivine (which is anhydrous), talc ($3MgO.4SiO_2.H_2O$), or even soapstone (an impure talc). Additional information as to possible uses for serpentine therefore will be awaited with interest.

Another inquiry relates to antigorite, a form of serpentine that has a platy rather than fibrous or asbestiform structure. As reported in the magazine Asbestos (December 1938, p. 38), a substantial deposit of relatively pure antigorite has been located in California, near Stockton. The same deposit also contains a mixture of pure antigorite and short-fiber asbestos that could be mined commercially.

STRONTIUM MINERALS

Available information on the strontium industry has been summarized in recent volumes of Minerals Yearbook; a general review appeared in Minerals Yearbook, 1935 (p. 1232). Bureau of Mines Economic Paper 4, Strontium from a Domestic Standpoint, is somewhat out of date but may be purchased from the Superintendent of Documents, Government Printing Office.

Strontium salts, notably nitrate, are used in the United States almost exclusively in pyrotechnics, the chief outlet being the red flares used by railway companies and truckers as warning signals.

A number of firms have indicated to the Bureau of Mines that they are possible producers of strontium minerals, and domestic resources of celestite are undoubtedly large. During 1938 the Bureau of Mines received many inquiries as to possible markets for strontianite, which recently seems to have been found in Gunnison County, Colo., near Parlin and in New Mexico. No domestic production of strontium ore has been reported since 1918, and domestic needs are supplied by imports. However, the Mudrite Products Co. of Houston, Tex., has recently mined impure celestite near Sweetwater, Tex., and ground it at Nacogdoches, Tex., for use as a new oil-well drilling mud admix. An analysis shows over 82 percent $SrSO_4$.

Except for an unimportant increase for precipitated carbonate, imports of strontium ores and compounds declined sharply in 1938. Imports for 1938 (1937 in parentheses) follow: Strontianite and (chiefly) celestite, 552,868 pounds valued at $2,824 (5,636,570 pounds, $20,877); strontium nitrate, 364,362 pounds, $23,921 (609,488 pounds, $40,243); and precipitated carbonate (this classification nominally includes oxide as well), 82,859 pounds, $8,502 (44,579 pounds, $4,610).

TOPAZ

Topaz is best known as a gem mineral but is not uncommon as a minor constituent of granites. Colorless topaz bears a superficial resemblance to quartz and is even more likely to be confused with phenacite, the illusive beryllium mineral that thus far has not been found in commercial quantities although often reported. Topaz is usually, but not always, harder than quartz and differs from quartz in that it has perfect basal cleavage.

A unique occurrence of massive topaz recently was discovered in the Brewer gold mine near Jefferson, Chesterfield County, S. C. According to a Geological Survey report [18] this deposit contains an

[18] Pardee, J. T., Glass, J. J., and Stevens, R. E., Massive Low-Fluorine Topaz from the Brewer Mine South Carolina: Am. Mineral., vol. 22, No. 10, October 1937, pp. 1058–1064.

enormous quantity of topaz unusually fine-grained in texture and low in fluorine. The hardness is only 7 (usually 8), and the specific gravity is the lowest ever recorded for topaz, probably owing to the low fluorine content (13.23 percent F). The percentage of silica is only 33, and that of Al_2O_3 is reported as 56.76 (some of which, however, represents AlF_3).

Attention has been given to commercializing the material, possibly as a refractory.

VERMICULITE

An outstanding development in the vermiculite industry in 1938 has been the progress in the utilization of smaller sizes. In Minneapolis, which has long been a leading market and where three expanding plants are now producing house fill, important sales of vermiculite plasters have been made recently. The vermiculite replaces the fiber and part of the sand, and the product has good heat- and sound-insulating properties. Of special interest is its use in school buildings to prevent transmission of noise by the steel framework. The fire resistance of such plasters is superior to that of plasters made from larger pellets of vermiculite which sometimes expand further when strongly heated, thereby causing cracks. Hitherto, sizes smaller than those used for loose house fill (minus 3- plus 14-mesh) have been difficult to dispose of, often having been thrown away at the mines, but other new uses are developing for finer sizes in conjunction with fireclay and bentonite for special refractories, including combustion chambers for oil-burner equipment. Visitors to the San Francisco World Fair will see expanded vermiculite sparkling in the walls of the buildings. To impart a distinctive finish to the 200,000 square yards of exterior stucco 140 tons of vermiculite, especially heat-treated to a bright golden color, was applied while the cement stucco was still wet.

These new uses failed to offset the decline in demand for home insulation, previously noted for mineral wool.

Vermiculite sold or used in the United States, 1936–38

Year	Short tons	Value	
		Total	Average per ton
1936	16,933	$185,787	$10.97
1937	[1] 26,556	[1] 260,664	[1] 9.82
1938	20,700	192,000	9.28

[1] Revised figures.

In 1938 raw vermiculite was produced commercially in the United States by two companies in Montana and one each in Colorado and Wyoming. Another concern made trial shipments from North Carolina. Although all the mining companies sell cleaned raw vermiculite, most of them have acquired one or more expanding plants so that they can sell their product more directly to the consumer. Prices of the raw material are approximately $12 f. o. b. Western mines and nominally $6 or $7 a ton f. o. b. North Carolina.

PART IV. MINE SAFETY

EMPLOYMENT AND ACCIDENTS IN THE MINERAL INDUSTRIES

By W. W. Adams

SUMMARY OUTLINE

The outstanding feature of the mineral industry of the United States in 1938 was a decline of 8 percent in the number of men employed, accompanied by an even more pronounced reduction in the number of man-hours worked—22 percent. Fortunately, this loss in employment was accompanied by a decreased number of accidents to employees. The reduction in accidents was proportionately greater than the decline in man-hours, so that the accident-frequency rate for a given exposure to occupational hazards was slightly more favorable in 1938 than in 1937.

Of the 21 branches of the mining industry for which separate figures have been compiled, 16 reported a decrease in the number of men employed and 5 showed virtually no change or possibly a slight gain in the number of workers. The five classes of operations that showed little or no loss in the number of workers were gold and silver mines, cement mills and quarries, limestone quarries, trap-rock quarries, and nonmetallic-mineral mines.

These general statements are based upon a comparison of reports covering identical plants for the 3 years 1936–38, inclusive. The plants selected were those for which reports for 1938 had been received in time for review in the current issue of Minerals Yearbook. The reports cover from 35 to 97 percent of the number of men employed in the 21 branches of the mineral industries to which the figures relate. Reports for bituminous-coal mines, the largest group of operations, covered 60 percent of the total number of workers.

The following table shows the number of men employed from 1936 to 1938, inclusive, in each of the 21 branches of the mining and allied industries. All figures for 1936 are complete and final, as are the 1937 figures for quarries, coke ovens, iron mines, copper mines, and anthracite mines. All other figures for 1937 and all figures for 1938 are subject to revision.

Number of men employed in the mineral industries of the United States, 1936–38

	1936	1937	1938 [1]
Coal mines:			
Bituminous-coal	482, 500	[1] 507, 000	469, 000
Pennsylvania anthracite	102, 082	99, 085	95, 000
	584, 582	[1] 606, 000	564, 000
Metal mines:			
Iron	18, 592	22, 957	18, 100
Lead-zinc (Mississippi Valley)	5, 689	[1] 7, 300	6, 600
Copper	14, 102	21, 200	17, 800
Gold, silver (including lead, zinc, copper)	47, 967	[1] 52, 000	52, 700
Miscellaneous (tungsten, manganese, etc.)	3, 195	[1] 4, 500	3, 600
	89, 545	[1] 108, 000	99, 000
Nonmetallic-mineral mines	11, 387	[1] 12, 000	11, 000
Quarries:			
Cement	26, 004	27, 215	27, 600

	1936	1937	1938 [1]
Quarries—Continued.			
Marble	3, 304	3, 647	3, 400
Slate	2, 565	3, 074	2, 600
Trap-rock	3, 111	2, 806	2, 800
Granite	8, 243	8, 961	8, 200
Sandstone	3, 122	3, 242	2, 700
Limestone	24, 288	24, 789	24, 900
Lime	9, 385	10, 360	8, 500
	80, 022	84, 094	81, 000
Coke ovens:			
Byproduct	16, 286	17, 850	12, 600
Beehive	1, 525	2, 192	1, 200
	17, 811	20, 042	14, 000
Metallurgical plants:			
Mills	13, 003	[1] 15, 300	11, 400
Smelters	16, 160	[1] 17, 900	14, 400
Auxiliary works	12, 004	[1] 14, 900	12, 200
	41, 167	[1] 48, 100	38, 000
Grand total	824, 514	[1] 878, 000	806, 000

[1] Subject to revision.

A summary table showing number of men employed, number of man-days worked, number of men killed by accidents, and yearly fatality rates for the mining and quarrying industries from 1911 to 1935 was published in Minerals Yearbook, 1937 (p. 1454). The following table contains similar data for 1931 to 1938, inclusive, not only

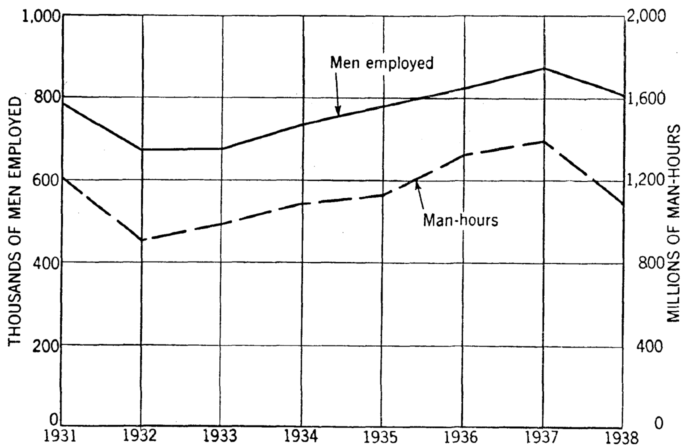

FIGURE 1.—Trend of employment in the mineral industries of the United States, 1931–38.

for mines and quarries but also for coke ovens, ore-dressing plants, smelters, and auxiliary works associated with ore-dressing plants and smelters. In addition, the table contains figures showing the number of nonfatal injuries and the nonfatal-injury rates. Figure 1 shows the trend of employment in the mineral industries since 1931, and figures 2 and 3 indicate the trend of accidents and accident rates, 1931–38.

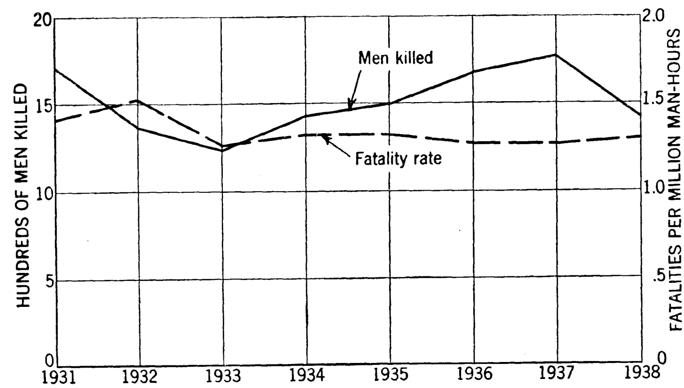

FIGURE 2.—Trend of fatal accidents in the mineral industries of the United States, 1931–38.

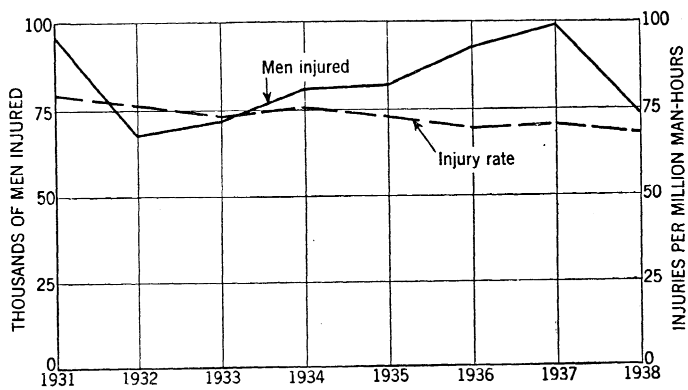

FIGURE 3.—Trend of nonfatal accidents in the mineral industries of the United States, 1931–38.

Employment and accident record of mineral industries of the United States, 1931–38

Year	Number of men	Man-days of employment	Man-hours of employment	Number: Killed	Number: Injured	Rate per million man-hours: Killed	Rate per million man-hours: 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 [1]	878, 000	190, 000, 000	1, 394, 000, 000	1, 769	98, 586	1. 27	70. 72
1938 [1]	806, 000	148, 000, 000	1, 087, 000, 000	1, 418	73, 515	1. 30	67. 63

[1] Subject to revision.

EMPLOYMENT AND ACCIDENTS

BITUMINOUS-COAL MINES

Employment.—The number of workers and number of man-hours worked in bituminous-coal mining, which employs more men than all other branches of the mineral industry of the United States combined, dropped in 1938 compared with 1937. Although final figures are not available for either year, reports thus far received from producing companies representing 60 percent of the industry indicate that the number of employees, which was 482,500 in 1936, rose to 507,000 in 1937 then fell to 469,000 in 1938—a loss of 30,000 or more employees in 1938 from the number working in 1937. The loss in man-hours worked at the mines was even more severe. The indicated number of man-hours worked in 1938 was 527 million, a loss of 24 percent from the tentative figure of 690 million for 1937 and of 21 percent from the final figure of 670 million for 1936. The corresponding drop in production of coal below 1937 was about 23 percent. An average of 160 workdays per man is indicated by the reports for 1938—a loss of 35 days per man compared with 1937.

Accidents.—The number of accidents to the mine workers in 1938 dropped sharply to 39,000 disabling injuries and 900 fatalities from 54,000 disabling injuries and 1,198 fatalities in 1937. The accident-frequency rate per million man-hours of employment or exposure to hazard was 75.7 compared with 80.3 in 1937 and 77.0 in 1936. Should these figures stand without material change when final figures for 1937 and 1938 become available, they will show that the safety record in 1938 was more favorable for the coal-mine workers than in any year since 1930 when, for the first time, complete reports of fatal and nonfatal injuries were collected for the industry.

ANTHRACITE MINES

Employment.—Although the number of employees at anthracite mines in Pennsylvania decreased only slightly (about 4 percent) in 1938 according to final reports for 1937 and an estimate based upon incomplete returns from the operating companies for 1938, a more severe decline (about 15 percent) occurred in the total man-hours worked in 1938. According to final and complete reports for 1937, 99,085 men were working at the mines, preparation plants, and breakers in that year. Preliminary returns that cover about 62 percent of the industry indicate that this number apparently declined to about 95,000 in 1938, but final returns may raise the figure slightly. A total of 116 million man-hours were worked in 1938, according to present estimates, compared with 136 million man-hours in 1937. The average period of employment was only 174 days per worker in 1938, a loss of 15 work days per man from the 1937 average.

Accidents.—The recession in employment at anthracite mines in 1938 was accompanied by a reduction in the number of injuries resulting from accidents to the workers. However, the decreased number of accidents did not keep pace with the decline in employment; therefore, the accident rate per unit of employment was less favorable than in 1937. The rate for fatal and nonfatal accidents in 1937 was 115.2 per million man-hours of work; this rate increased slightly in 1938 and, according to preliminary data, reached 118.9 per million man-hours. Both years, however, had more favorable rates than 1936, when the rate was 123.4.

IRON-ORE MINES

Employment.—Measured by the number of man-hours worked, employment at iron-ore mines decreased decidedly in 1938. The number of man-hours of work performed declined 39 percent, compared with 1937, according to reports now available which cover about 92 percent of all employees in the industry. The drop in man-hours worked was more severe for open-cut mining (57 percent) than for underground operations (35 percent). The decline in number of employees was much less severe. A 22-percent reduction was indicated in the total number of workers—the net result of a decline of 12 percent for underground employees, 48 percent for men at open-cut mines, and 16 percent for surface employees. A loss was also reported in the number of workdays per employee in 1938, the figure being tentatively set at 194 days in 1938 compared with 249 days in 1937 and 232 days in 1936.

Accidents.—Accidents were strikingly fewer, and in proportion to employment in 1938, only about one-third as many men were injured as in 1937. The tentative rate for 1938 shows only 16.1 fatal and nonfatal injuries per million man-hours worked compared with 30.8 in 1937 and 25.9 in 1936.

COPPER MINES

Employment.—Although much copper is produced by mines whose ores are valuable chiefly for some other metal, the employment and accident figures of the Bureau of Mines cover only mines whose ores are valuable primarily for their copper content. It is manifestly impossible to segregate employment and accident data for a mine according to the various kinds of metal contained in the ores that the mine produces. Mines whose chief output was copper employed approximately 17,800 men in 1938, according to reports from companies whose employees represent about 91 percent of the total number of men working at all copper mines. This indicates a decrease of 16 percent from the number of men employed in 1937 but a gain of 26 percent over 1936. The prevailing working time was 8 hours a day, and the total number of man-shifts worked at all mines averaged 243 workdays per man, a loss of 64 days per man from 1937.

Accidents.—Marked progress was made in the prevention of accidents in copper mines in 1938, the accident-frequency rate being much lower than that for either 1937 or 1936. The indicated rate for 1938 was 56.3 per million man-hours of employment compared with 95.9 for 1937 and 81.9 for 1936. The actual number of injuries to the employees in 1938 was considerably less than in 1937 owing mainly to the fact that fewer men were working and partly to the fact that the workyear was shorter in 1938. The reports from the operators showed, however, that accidents decreased faster than employment, hence the improvement shown as a reduction in the accident rate per million man-hours of employment.

LEAD AND ZINC MINES (MISSISSIPPI VALLEY STATES)

Employment.—Measured by the number of man-hours worked, employment at lead and zinc mines in the Mississippi Valley States declined about 25 percent in 1938, according to operating companies' reports to the Bureau of Mines covering about 58 percent of the employees at the mines. On the other hand, the number of men working was only about 9 percent less than in 1937. In contrast, the working force in 1938 represented a gain of 17 percent compared with 1936. The workyear was comparatively short, consisting of only 201 days per man in 1938, according to information now available, compared with a tentative figure of 240 days for 1937 and a final figure of 226 days for 1936.

These figures are for lead and zinc mines only; they do not include data for fluorspar mines in Illinois and Kentucky, which are sometimes combined with lead and zinc mines in the Mississippi Valley States.

Accidents.—A small increase was reported in the accident-frequency rate for lead-zinc mines in 1938, but it may not be sustained when complete reports from all producing companies have been received. The estimated rate for 1938 per million man-hours worked, based upon reports thus far furnished, was 61.5 compared with 60.4 for 1937. Both rates are higher than the rate of 54.6 for 1936.

GOLD AND SILVER MINES

Employment.—This group comprises mines that produced ores containing any one or more of the five major metals—gold, silver, copper, lead, and zinc—except mines whose output was valuable chiefly for the copper content of the ore and mines in the Mississippi Valley States operated for lead or zinc. The category therefore includes lead-zinc mines in all States outside of the Mississippi Valley region and mines whose ores, although containing some copper, were valuable chiefly for some other metal. Placer as well as lode mines are included.

From a total of 47,967 employees in 1936 the number rose to an estimated 52,000 in 1937 and remained virtually the same in 1938, according to reports from many, but not all, operating companies. However, the amount of employment per worker was less in 1938 than in either 1936 or 1937, as the smaller number of man-hours shows. The total volume of employment was 93 million man-hours in 1936 and, according to reports now available, about 94 million in 1937 and 91 million in 1938. Each employee, excluding those at placer mines, averaged 259 working days in 1936 compared with an estimated 239 days in 1937 and 241 days in 1938. The average working time per employee at placer operations cannot be given for 1937 and 1938 at this time but was 174 days in 1936.

Accidents.—The accident rate for this group of mines has been increasing during the past 3 years. The combined rate for lode and placer mines was 94.8 in 1936 and, according to data now available, increased to 107.8 in 1937 and 111.1 in 1938.

MISCELLANEOUS METAL MINES

Employment.—This group covers all mines whose ores were valuable chiefly for their content of some metal other than gold, silver, copper, lead, zinc, or iron. It therefore comprises mines that produced quicksilver, tungsten, manganese, and various other metals. Approximately 3,600 men were working in mines of this group in 1938, according to information in reports from companies whose workers include about half of all employees at such mines. The number of men working was 22 percent less than in 1937 but 10 percent more than in 1936. The average number of days worked per man was 244 in 1938, indicating a loss of 17 workdays per man compared with 1937, but a gain of 4 days per man compared with 1936.

Accidents.—The accident-frequency rate for this group of mines was not as favorable in 1938 as in 1937. Present reports indicate that the 1938 rate was 71.9. Reports for 1937 showed a rate of 63.7 and for 1936 of 89.1.

NONMETALLIC-MINERAL MINES

Employment.—The number of men working at nonmetallic-mineral mines in 1938 decreased about 8 percent from 1937. A more serious reduction in employment was indicated by the total number of man-hours worked, which was 14 percent less than in 1937. These declines are based on reports from companies representing about 54 percent of all employees at mines in this group. The total working time for all employees averaged 239 days per man compared with 254 days per man during 1937. Mines in this group comprise all classes of non-metallic mines, including those that produced phosphate rock, fluorspar, gypsum, salt, sulfur, or any of various other nonmetallic minerals.

Accidents.—Accidents in these mines declined also, and the decrease in number of accidents was proportionately greater than that in number of employees. Therefore the accident-frequency rate was more favorable in 1938 than in 1937. Tentative figures show an accident rate of 39.7 for 1938 compared with 47.5 for 1937 and 50.7 for 1936.

CEMENT MILLS AND QUARRIES

Employment.—A slight increase in number of workers was reported for cement mills and quarries in 1938, but there were reductions in the total number of man-hours worked and in the average number of workdays per employee. On the basis of reports from companies representing about 89 percent of the total number of workers, the industry as a whole employed about 27,600 men compared with 27,215 in 1937. The estimated number of man-hours worked was 48 million compared with 56 million in 1937. An average of 236 workdays per man was indicated for 1938, a reduction of 42 days per man from the average for 1937.

Accidents.—That progress was made in the prevention of accidents in 1938 was shown by a reduction in the accident-frequency rate from 12.2 in 1937 to 9.7 in 1938. This low accident rate for cement mills and quarries was the most favorable one reported by any branch of the mineral industry in 1938 except byproduct coke ovens, whose rate was 7.5.

MARBLE QUARRIES

Employment.—Reports from companies representing about 88 percent of the total number of men working in and about marble quarries showed that the entire industry employed approximately 3,400 men in 1938, a reduction of about 7 percent from the 3,647 men employed in 1937. The total number of man-hours worked declined 5 percent to 6.5 million man-hours in 1938 from 6.9 million man-hours in 1937. The loss of 7 percent in number of workers and of only 5 percent in man-hours worked indicated a slight gain for the average worker in the number of workdays available during the year; the working time averaged 235 days per man in 1938 compared with 230 days per man in 1937.

Accidents.—In spite of a slight loss in total man-hours of employment accidents increased, both in number and in relation to volume of employment. Tentative figures show an accident-frequency rate of 58.3 per million man-hours worked in 1938 compared with 50.9 in 1937.

SLATE QUARRIES

Employment.—Reports representing approximately 71 percent of all men employed at slate quarries in the United States indicate that the industry had 2,600 employees in 1938, or 15 percent less than in 1937. This decline in the number of employees was accompanied by a larger decline in the number of man-hours worked. Tentative figures show a total of 4.1 million man-hours of employment, a reduction of 32 percent from the 6.0 million man-hours in 1937. A large reduction also was reported in the average working time per man, which fell from 232 days in 1937 to 186 days in 1938.

Accidents.—The decline in number of accidents in 1938 was not as great as the drop in employment, hence the accident-frequency rate increased from 56.9 in 1937 to 62.1 in 1938.

TRAP-ROCK QUARRIES

Employment.—There was virtually no change in the number of men working at trap-rock quarries in 1938 compared with 1937. Moreover, only a slight reduction (about 4 percent) was indicated in the number of man-hours worked in 1938. The industry employed 2,806 men in 1937, and tentative reports show 2,770 men employed in 1938. Measured in man-hours, employment was 4.3 million in 1938 compared with 4.5 million in 1937. The average working time per man was 192 days in 1937 and apparently did not change in 1938.

Accidents.—The accident-frequency rate dropped notably in 1938 from the strikingly high figure for 1937, the tentative rate for 1938 being 44.7 per million man-hours compared with the final rate of 75.8 for 1937. The rate for 1936 was 60.3.

GRANITE QUARRIES

Employment.—Reports from operators of granite quarries that employ approximately 56 percent of all men working in the industry indicate a reduction of 8 percent in number of workers and 15 percent in number of man-hours worked in 1938 compared with 1937. The number of workers was 8,961 in 1937 but declined to about 8,200 in 1938, according to reports thus far received. All workers were employed approximately 13.6 million man-hours in 1938 compared with 16.1 million in 1937. Returns now available indicate a total of 210 workdays per man in 1938 compared with 226 days in 1937 and 224 days in 1936.

Accidents.—Marked progress was made in the prevention of accidents in 1938, as was shown by a substantial reduction in the number of accidents to employees and in the accident-frequency rate per million man-hours worked. The indicated rate for 1938 was 38.4 compared with 54.0 for 1937 and 52.2 for 1936.

SANDSTONE QUARRIES

Employment.—Losses in the number of men working and the number of man-hours worked were shown by returns from operators of sandstone quarries in 1938. The industry apparently employed a little more than 2,700 men, or about 15 percent less than in 1937, and worked about 3.6 million man-hours—35 percent less than in 1937. The average employee worked 159 days in 1938, the corresponding figure for 1937 being 204 and for 1936, 201.

Accidents.—Substantial improvement was reported in the elimination of accidental injuries to employees in 1938. Not only was the actual number of injuries reduced, but also the accident rate was more favorable in relation to volume of employment than in 1937. A tentative rate of 39.4 accidents per million man-hours was shown by reports for 1938 compared with 75.3 for 1937 and 48.2 for 1936.

LIMESTONE QUARRIES

Employment.—This group of operations covers all limestone quarries except those whose product is used chiefly for the manufacture of cement or lime. According to reports from companies whose employees comprise about 49 percent of all workers in the industry, the number of men employed in and about the quarries has remained fairly stationary during the past 3 years. The number of men working is estimated at 24,900 in 1938 compared with 24,789 in 1937 and 24,288 in 1936. Although the number of workers remained about the same, reports thus far received for 1938 indicate that the number of man-hours declined 16 percent below 1937 and 11 percent below 1936. Moreover, the average working period per employee apparently was only about 174 days in 1938, or 28 days less than in 1937 and 20 days less than in 1936.

Accidents.—Based on data now available, the accident-frequency rate for limestone quarries increased in 1938 to an estimated 59.8 accidents per million man-hours of employment. In 1937 the rate was 53.9, and in 1936 it was 55.0.

LIMEKILNS AND QUARRIES

Employment.—A drop of 18 percent in number of employees and 27 percent in man-hours worked was indicated for 1938 by reports received from companies operating limekilns and quarries. The working force comprised 8,500 men compared with 10,360 men in 1937, and the period of employment for the industry as a whole was 16.5 million man-hours in 1938 compared with 22.5 million man-hours in 1937. A loss of about 25 working days per employee from the 281 days in 1937 was shown by the reports for 1938.

Accidents.—A little progress was made in the prevention of accidents in 1938. The indicated rate for the year is 52.2 accidents per million man-hours worked compared with 54.7 in both 1937 and 1936.

BYPRODUCT-COKE OVENS

Employment.—The number of men employed in the byproduct-coking industry of the United States fell 30 percent and the number of man-hours worked dropped 31 percent during 1938 according to reports from companies that represented approximately 97 percent of the total number of workers at all plants. The average working period was 347 days per man in 1938 compared with 360 days in 1937 and 365 days in 1936. These figures as to the length of the work year do not imply that any given employee worked the number of days indicated; rather they mean that the ovens averaged the indicated number of workdays for the "average" employee. The word "average" here signifies the mathematical mean, or the quotient obtained by dividing the total number of man-days by the total number of oven-days at each operation.

Accidents.—The accident-frequency rate for the byproduct-coking industry was more favorable than the corresponding rate for any other major group of the mineral industry, including mines, quarries, coke ovens, and metallurgical plants. Available reports for 1938 indicate an accident-frequency rate for this class of ovens of about 7.5 per million man-hours worked. The excellence of the safety record shown by this low rate may be seen by comparing it with an average rate of 68.9 for all mineral industries combined. The rate for by-product ovens in 1937 was 8.5, and that in 1936 was 8.7.

BEEHIVE-COKE OVENS

Employment.—After increasing from 1,525 men in 1936 to 2,192 men in 1937, the number of employees at beehive-coke ovens in the United States dropped to 1,200 in 1938, according to reports from operating companies whose employees comprise about 62 percent of the total number at this class of ovens. Compared with 1937 the reduction in number of workers in 1938 was 46 percent. The number of man-hours worked at all ovens decreased 63 percent—from 3.28 million in 1937 to only 1.23 million in 1938. The average working time per employee was 150 days in 1938 compared with 213 days in 1937 and 183 days in 1936.

Accidents.—The decline in employment was accompanied by a gratifying reduction in the accident-frequency rate and in the actual number of injuries to the employees. An estimate for 1938 indicates an accident rate of 28.4 per million man-hours of employment, compared with the rate of 48.5 for 1937 and 36.0 for 1936.

ORE-DRESSING PLANTS

Employment.—A reduction of about 25 percent in number of employees at ore-dressing plants in the United States was indicated by reports for 1938 from companies that employ approximately 48 percent of the total number of workers in this branch of the mineral industry. The number of man-hours of work done during the year declined 37 percent. Available reports indicate that the total number of men employed in 1938 was 11,400 compared with 15,300 in 1937, and that the man-hours of labor performed totaled 20.5 million in 1938 as against 32.7 million in 1937. The average employee worked 226 days in 1938, or 42 days per man less than in 1937.

Accidents.—The accident rate was more favorable in 1938 than in 1937, as was also the actual number of men injured. The tentative rate for 1938 was 27.8 per million man-hours of employment compared with 33.8 for 1937 and 29.7 for 1936.

SMELTERS

Employment.—Employment at smelters in the United States declined 19 percent in 1938 when measured by the number of men working and 22 percent when measured by the number of man-hours worked. Reports that covered approximately 88 percent of the workers at all establishments showed that the smelting industry as a whole employed about 14,400 men who worked a total of 35.1 million man-hours in 1938 as compared with 17,900 men who worked 45.2 million man-hours in 1937.

Accidents.—The accident-frequency rate for 1938 was more favorable than that for 1937 and about the same as the rate for 1936. The indicated rate for 1938 was 19.9 accidents per million man-hours worked, while that for 1937 was 22.8 and for 1936, 20.6.

AUXILIARY WORKS AT ORE-DRESSING PLANTS AND SMELTERS

Employment.—Employment at ore-dressing plants and smelters, covering employees not directly connected with milling and smelting processes, was somewhat less in 1938 than in 1937 but did not differ materially from that in 1936. An estimate based upon reports from companies representing about 81 percent of all workers indicated a total of 12,200 men employed in 1938, about 2,700 less than in 1937. Final reports for 1936 showed a total of 12,004 men employed. The number of man-hours worked was 29 million compared with 38 million in 1937 and 30 million in 1936. Employment averaged 299 days per man in 1938. In 1937 the average was 320 days per man, while in 1936 it was 318 days.

Accidents.—The safety record was more favorable in 1938 than in either 1937 or 1936. The actual number of persons injured was much below that of either 1936 or 1937. According to reports now available, the accident-frequency rate per million man-hours worked was 16.1, which compares favorably with rates of 26.9 for 1937 and 18.5 for 1936.

SUMMARY, 1931–38

Bureau of Mines records of the number of man-hours of work performed in all branches of the mining and quarrying industries were compiled first for the calendar year 1931. Figures giving this information, as well as accident rates, for 1931–38, are shown in a preceding table.

The period 1931–38 included the year 1932, when employment in the mining and allied industries in the United States reached its lowest point. From 1932 to 1937 employment increased uninterruptedly, but in 1938 some of the previous gains were lost.

If the record for 1932, the low point of the depression, is chosen as a basis for comparison and is represented by an index of 100, the improvement in 1937 and 1938 may easily be seen. With an index of 100 for 1932, the number of men employed in 1937 would be represented by an index of 131, an increase of 31 percent over 1932, and the number of workers on the rolls in 1938 by 120, or 20 percent higher than in 1932. The index of man-hours worked reached 155 in 1937 and dropped back to 121 in 1938.

Owing to the greater volume of employment in 1937 and 1938 than in 1932, accidents also increased in number but not as fast as employment, hence the accident-frequency rate declined in relation to volume of employment. The actual number of accidents raised the index to 143 in 1937 and 107 in 1938. As these indexes were smaller than those for man-hours, it follows that the accident rates for 1937 and 1938 were more favorable than the rate for 1932. The accident rate per million man-hours in 1932, the base year, was 77.9. This rate was lowered to 72.0 in 1937 and 68.9 in 1938. The rate for 1938 was the lowest since records of accidents in relation to man-hours of exposure to occupational hazards first became available for the mineral industry of the United States in 1931.

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